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RESECTION OF THE LUNG FOR SUPPURATIVE INFECTIONS WITH A REPORT BASED ON 31 OPERATIVE CASES IN WHICH RESECTION WAS DONE OR INTENDED

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IN the literature of surgery there is little to be found on resection of the lung for what may be called suppurative bronchiectasis. In a recent search there were found less than thirty cases. The majority of surgeons appear to have been content with palliation, and in most instances the patient goes about during his periods of remission merely waiting for the next exacerbation and not able to count on any particular period of uninterrupted usefulness. Occasionally an individual coughs his way through life—never a long one—and manages to exist as a semi-invalid, the copious, foul expectoration which no medicine can control being a handicap difficult to bear. Patients have even threatened suicide if refused the chance for cure by operation though they knew that the danger was great.

It is not a simple matter to decide what to do. To refuse to operate upon a wretched patient, otherwise incurable, merely because the statistics may be unfavorable, seems hardly fair; yet, one of the functions of our profession is the prolongation of life and what we call an operative death is always a calamity. The first important problem, then, is to determine what class of cases is suitable for the radical step of lobe resection. If anything less dangerous promises a cure † or a tolerable existence with the ability to earn a livelihood, lobectomy should be abandoned in its favor. But it must not be forgotten that any operation which glues the diseased lung to the chest wall over a wide area will, in case of failure, prevent subsequent lobectomy. I say this judging by my own experience. Robinson, Sauerbruch and others appear to recommend extirpation of a lobe in several stages even after bronchial fistulæ have formed. The difficulties and dangers of this procedure, however, are probably greater than those of a one- or two-stage typical lobectomy.

I feel that it is time I reported my experience in this field of surgery. My first case of lobectomy bears the date of February 27, 1914. Counting out a year's absence (1918) this leaves six working years with 31 cases.

* Read before the New York Surgical Society, December 14, 1921.

† No method known to me.

In 14 of these, in which a single lobe was removed for disease limited to that lobe, six died, or 42.8 per cent. In 10 cases, in which the disease was not limited to a single lobe and in which more was done than the removal of a single lobe, there were seven deaths, or 70 per cent. In the remaining seven cases lobectomy had been intended but could not be completed, sometimes nothing but an exploration having been made. Five of these patients died although there was no fatality on the table. One seems absolutely well (Case No. 31) one and a half years after thoracotomy and mobilization, and the other (Case No. 12) has a bronchial fistula and is in the hospital.

While the mortality rate seems high, it must be remembered that there are included all cases in which at operation lobectomy was performed or intended, not necessarily even attempted. The cases have been unselected except that they were all supposed to have been unilateral. In all except two of my finished cases the patient, if he survived, may be considered cured; which means that all wounds are healed and that the patient is able to live a normal life, working and exercising as usual, although no one has thus far engaged in occupation involving heavy manual labor. One of these patients (Case No. 21) still has productive cough, but without odor and the presumable cause, nasal pansinusitis, is still present and under treatment. The other (Case No. 3) is working at his occupation, that of secretary, and has been continuously thus employed since he left the hospital. (Reported in *Surgery, Gynecology and Obstetrics,* November, 1919.)

These apparently modest statistics are presented because I believe that I have here enough cases to form the beginning of a working basis in determining the danger of operation in the various forms of lung suppuration which are here represented. It appears to me, then, that in selected cases we may count upon the survival of 50 to 60 per cent. of the patients, nearly all of whom will have been actually restored to health by surgery. And this percentage is by no means discouraging. Compared with those in which palliation, so-called, has been secured and compared with the mortality rate of other surgical diseases of like gravity, and considering the present stage of this newly developed side of thoracic surgery, any percentage of cures over forty may be considered excellent.

As an example of an unsuccessful operation intended for relief I will cite the case of *Mrs. J. P.* After a year of misery following a post-tonsillectomy lung infection, an abscess was drained in two stages, but little relief followed. Four years later she came to me, a frail little woman, with clubbed fingers, fœtid breath, with cough and foul sputum, and with a discharging wound in her back from which escaped pus as foul as that which was expectorated. Surely this attempt at palliation had not been worth the effort. Before reaching my present conclusion in regard to resection of these suppurating lungs, I myself have operated upon patients by this attempted drainage. I saw my patients die of hæmoptyses, or of sepsis without relief. I also succeeded in securing

some drainage with limitation of cough by means of bronchial fistula formation, but here also there were exacerbations with cough and fetor. The only patients who appear to be happy, normal beings, are those who have recovered after radical resection.

Indications and Contra-indications.—First: Children and young adults are by far the best subjects. After the age of thirty-five the operation becomes extra-hazardous because the resiliency of the patient is impaired. With or without sepsis it is the power of the heart to adapt itself which is perhaps the greatest factor in determining resistance. While this is practically so in all surgery it appears to be more striking in resection of the infected lung. This is of importance in regard to prognosis. It does not mean that we should deny older persons the benefits of surgery in incurable disease, but it does mean that we must frankly make known the added risk when the patient is more than, say, thirty-five. In any event, digitalization should be accomplished in the forty-eight hours preceding operation.

Second: The distribution of the morbid process. For example, a patient with a bilateral suppuration would be considered an unsuitable subject. Cases in which there is dense infiltration close to the mediastinum are extra-hazardous, and while suitable for exploration will probably not come to resection. (See Case No. 31.)

Third: An individual thirty-five years of age or more, who has been previously operated upon with resulting dense adhesions and perhaps fistulæ, would be almost an unwarrantable surgical risk. If palliation can be secured through drainage by bronchial fistula, the time might come, perhaps, for eventual resection; but I have not succeeded in saving one of these patients. (See Case No. 9.)

Fourth: The coexistence of other serious disease, such as cardiac, renal, or grave metabolic disturbances. In a syphilitic, lobectomy should not be performed until the Wassermann examination is negative and has been so for months.

This Wassermann examination must be made in every case in which another exciting cause, such as aspiration of a foreign body, tonsillectomy, etc., cannot be assigned. Or even as a routine in every case. Syphilitic deposits pressing upon one of the branches of the bronchial tree may be the cause of a bronchiectasis which can be relieved by anti-luetic treatment. In one of my patients there were for years the characteristic symptoms of suppurative bronchiectasis confirmed by X-ray; there were lesions in both lungs. Finally an empyema developed from the perforation of one of these bronchiectatic abscesses into the pleura. Following the surgical treatment of the empyema, combined with anti-syphilitic medication, this patient made a complete recovery.

Fifth: Systolic pressure of less than 100, while not a contra-indication for ultimate operation, would make postponement advisable.

When a patient has suffered for more than six months on account of

suppurative bronchiectasis, suppurative pneumonitis, or multiple parenchymatous lung abscess with cough and foul, copious expectoration, with febrile exacerbation and sepsis, it is probable that nothing short of the actual removal of the diseased portion of the lung will restore health. Also, the so-called drainage operations, in any except a few discreet or single abscesses of the lungs, probably parenchymatous, promise little. Palliative measures should be reserved for those absolutely unsuitable for radical surgery, such as persons in advanced age or with bilateral disease. According to Sauerbruch, it is desirable to close the thoracic bronchial fistulæ if the patient has been otherwise well for a long time; but he admits that this is by no means a simple procedure or devoid of danger.

As a rule the patient will not come for radical treatment until he has been ill for many months, or even years, and has become heartily tired of his condition. In my cases the mean duration of the illness before coming to operation has been one year.

Typical lobectomy in acute gangrenous conditions is little known. Perhaps the case of *Gertrude K.* should fall under this head. Here, immediately following tonsillectomy, the patient had what was supposed to be an "ether pneumonia." It proved to be a left lung suppuration. Although this particular patient died from sloughing of a vessel wall, perhaps we shall find that in the lung as in other parts of the body moist gangrene is best treated by ablation. If operable pulmonary suppuration were as common as gangrenous appendicitis, surgeons would learn how to deal with it; and I may say by the same means, extirpation.

Management of the Case.—Before accepting the case for operation, the state of affairs is fully explained to the patient and his family and the operative risk is gone into in detail. They should request me to operate; I do not try to persuade them.

Date of Symptoms.—A superstitious person might find an excuse for his infirmity in the large number of post-tonsillectomy lung infections in which cough and foul expectoration first occurred on the thirteenth day after operation. Rarely have I observed the beginning of the symptoms before the fifth day; still more rarely after the eighteenth day. In from ten to fourteen days in most of these cases the disease has declared itself.

Extent of the Disease.—The size of the lesion is not always indicated by the daily output of sputum. I have seen a quart of foul mucopus issue daily from a middle lobe bronchiectasis without remission for many months, while in other cases an upper or lower lobe had been the seat of extensive suppurative bronchiectasis with only ten to twelve ounces a day, and with remissions during which there was little or no sputum.

Bronchoscopy and X-ray Examination.—Within limits, the more one knows of the location and character of the disease before operating the better. But though I heartily favor bronchoscopy, it need not be employed in every case. After all, the chest is to be opened, and opened widely, and conditions may then become apparent that could not possibly have been predicted. The

really necessary things to know are (1) whether the disease is in the upper or the lower part of the chest; (2) whether it is near the hilum or near the periphery; and (3) whether there is perhaps a foreign body or a tumor present in the bronchus as a cause of the suppuration.

The X-ray may show all these things. In making radiographs in all chest cases, the upright position is the best for completeness. The diaphragm is low and the chest capacity greatest. In the prone or supine posture the diaphragm is crowded upward by the abdominal viscera and in its turn distorts the appearance of the thoracic organs. Level lines in the presence of air and fluid cannot be seen when the patient is recumbent with the rays passing from front to back or vice versa. When the patient cannot be placed upright, the exposure may be made anteroposteriorly while he lies on his unaffected side. Fluid levels may thus be demonstrated, and by taking the picture in both positions the size of the cavity can be estimated and unsuspected ones may be discovered.

Sometimes, however, bronchoscopy will reveal what the X-ray cannot disclose. For instance, the X-ray may show a triangular shadow and the history may indicate the presence of intrapulmonary suppuration; but the bronchoscopist may find and remove an aspirated lemon seed, radiotransparent, which caused all the trouble. Also, it may be convenient to know whether the pus is coming from one or more lobes when the X-ray shadow leaves one in doubt—this more as a matter of prognosis than influencing technic.

Examination of Sputum.—Examination of the sputum for tubercle bacilli is a necessary precaution. It occasionally happens that a few scattered acid-fast bacteria have been observed on one or two slides only, with numerous negative tests between. When there is a large quantity of sputum and concentration tests fail to show tubercle bacilli, in the majority of examinations, their absence may be assumed. In the cases in my list in which occasional bacilli have been found, I have an idea that there was an error in technic. Possibly the slides of two patients were confused; perhaps even the positive slide may have been a dirty one. It does not take much dirt to carry eleven bacteria, such as were found on a solitary occasion in the case of *Mrs. E. M. B.* (Case No. 1.)

Preoperative Preparation.—Two days of postural preparation are desirable excepting in the rare cases of emergency. The patient usually knows how to empty out the bronchial passages when there has been a considerable daily discharge. Sometimes the pus is more easily expelled when the patient inverts himself in the prone or in the supine position; sometimes when he lies upon the unaffected side and rarely when he lies upon the diseased side. If he has not made these observations, better take an extra day to experiment. At any rate it is best to have the lung as empty as possible so as to minimize the danger of overflow into the healthy side, especially as the patient must lie on the sound side on the operating table. The emptying should be done at least twice daily and also an hour before the operation.

As mentioned before, it is advisable to digitalize for forty-eight hours.

Three-quarters of an hour before operation a full dose of morphine and atropine should be given.

The patient's blood must be grouped and a suitable donor secured.

Precautions Against Hemorrhage.—The method of saving blood by segregating it in one or more extremities is an old one. Its practical application to surgery, however, was emphasized by the late R. H. M. Dawbarn, of New York. At the suggestion of Dr. A. J. Bendick and with his assistance the writer, some years ago, made observations with the syhygmomanometer which showed that in normal individuals the blood-pressure may be lowered by 40 to 60 millimetres of mercury following the segregation of blood in the legs brought about by ligating both thighs close to the body. We used elastic bandages and the pressure applied was just sufficient to impede the venous return, causing a swelling and cyanosis of both extremities. The blood-pressure, as shown in the pulse readings, falls rapidly, and faintness may even be induced on account of the bleeding of the subject into the veins of his legs. On removing the constriction it takes about one hour for the normal pressure to become reëstablished. According to Doctor Dawbarn, this blood segregation with its attendant lowering of pressure is of great value in preventing the loss of blood from the smaller vessels during an operation, and the writer has many times demonstrated the truth of this observation. Still, there is always the danger of recurrent hemorrhage when the normal pressure returns, because sufficient time has not elapsed for firm coagulation in the vessel-mouths. In my later cases, therefore, I have feared to employ this method and have relied more upon the intramuscular sodium citrate injections of Neuhof and Hirschfeld. When injected into the glutei just before the operation begins, while the patient is anæsthetized, a great drop in the coagulation time is noted within twenty minutes. For an average adult, 15 c.c. of a 30 per cent. solution of sodium citrate in sterile water is thrown into each buttock. The effect continues for about twenty-four hours and by that time firm coagulation has taken place. Perhaps in exceptional cases both methods might prove valuable.

Selection of Team, Anæsthetist, Assistant and Nurse.—An anæsthetist, especially experienced in this class of work, will save the surgeon much anxiety during the trying time on the table. These operations must be performed quickly and the surgeon's attention should not be distracted unnecessarily by the alarms of the inexpert.

Whenever possible the first assistant should be a man of mature experience and a good operator who knows what to do and how to do it without being told.

I know of no class of cases in which the result is more surely influenced by the nursing than in the post-operative period of lung resection for suppuration. Mt. Sinai Hospital has been most generous in furnishing special nurses for all of these cases, and also in securing donors for blood transfusion. The changes from hour to hour, and sometimes from minute to minute, are often tremendous, the patient's condition swinging from apparent well-

being to the picture of impending death. The nurse who knows surgical thoracic cases will be prompt to sense danger; she will at once summon the surgeon, tiding over the interval with a sedative hypodermically administered.

Anæsthesia.—After consciousness has been lost following nitrous-oxide and oxygen anæsthesia, ether should be used to secure complete relaxation and deep narcosis, then nitrous oxide, using a little ether according to necessity. In spite of what we have heard from certain eminent operators from abroad as a result of their observations in the War, I know from civil as well as war experience, that when there are few or no adhesions differential pressure nearly always is an absolute necessity. I have abandoned the intratracheal for the simpler and less dangerous intrapharyngeal method. When the more healthy part of the lung happens to be adherent to the chest wall, ordinary inhalation anæsthesia may suffice, but no matter how extensive or virulent the lung infection is, unless there has been perforation into the pleura, or numerous preoperative exploratory punctures have been made, astonishingly few adhesions will be observed. In the paragraph on two-stage versus one-stage lobectomy, this matter will be discussed.

As to the apparatus required, it is of the simplest. To be sure, a nice little electric contrivance with pump and suction silently running, such as the one devised by Doctor Branower, may be a luxury, but the ordinary dental foot bellows or at a pinch even a Paquelin bulb will furnish all the air pressure necessary. A manometer when the chest is open is unnecessary because the operator can easily determine by the appearance of the healthy lung when dangerous force is being used. The pneumatic chamber is here unnecessary.

The anæsthetic, gas or vapor, passes through a rubber tube of size about 14 French for an adult, placed through one nostril, just as far as the pharynx (about 3½ inches), the distance being clearly marked on the tube. Through too long a tube air may be forced into the stomach, a most disagreeable accident. To increase the amount of pressure, the anæsthetist places his hand over the closed lips of the patient with one finger shutting off the opposite nostril. Differential pressure may also be secured with an ordinary well-fitting nitrous-oxide mouthpiece without the nasal tube, the gas as it comes from the tank having all the necessary pressure and the balloon acting also as an indicator. Should vomiting occur, however, or should suction be required to empty the pharynx or trachea, the gas mask must be removed, thereby permitting lung collapse. I therefore prefer the tube method.

If it seems desirable to distend the healthy lung at the close of the operation, this can easily be done just before the last stitch is tied.

Posture on the Table.—The patient lies upon the unaffected side, but slightly prone, a pillow beneath the head, the back bowed forward, the thighs flexed and a thin pillow between the knees. There should be a sandbag front, or front and back as required. Belting or bandages are used around the table, taking in the patient's thighs and legs to preserve the attitude. The arm of the affected side is raised and drawn forward so as to pull the

scapula as far out of the way as possible. The position on the table should be such that the elevating bridge comes beneath the lower ribs, and when the bridge is raised a degree of scoliosis is produced with widening of the intercostal spaces.

Should There Be One or Two Stages?—The decision between a one-stage, a two-stage, or a many-stage operation for the resection of a suppurating pulmonary lobe can be made only after the chest is opened. Here are the arguments:

First: The mere exploration of the thoracic cavity through a long intercostal incision with rib-spreading is not a shocking thing. The patients are usually out of bed in three or four days. There is no embarrassment either of respiration or of heart action, and this is true in older patients as well as in more youthful ones. But the operation takes time, and time is probably the most important element in thoracic surgery. If, now, immediately after our exploration we proceed to perform a lobe extirpation, the fifteen minutes more or less may have proved to be just enough to turn the scale.

Second: After a one-stage lobe resection, there are important changes in what may be called the balance of the heart. This is further accentuated when there is a collapse of the healthy part on the same side; and even when at the end of the operation the lungs have been distended by the differential pressure, a certain amount of collapse will quickly occur because of the rapid outpouring of exudate into the pleural sac. In young and vigorous individuals the circulation adjusts itself and the immediate danger from the operation gives place to the more remote one of infection.

Third: Suppose that at the primary operation we find numerous old inflammatory adhesions between the healthy lung and the chest wall, or suppose even that the entire pleural cavity has been obliterated by such adhesions; it is obvious then that so far as the danger of lung collapse or mediastinal commotion goes, we may as well proceed at once to complete the operation. Differential pressure is not needed; the patient breathes as quietly as if the chest had not been opened. (See case of *David J.*, No. 14.)

Fourth: It may become a matter for fine decision, however, when we find at the first operation a few adhesions of healthy lung to the chest wall. One should then observe how much collapse occurs when the differential pressure is intermitted. If the collapse seems too great, it would be better to prepare the patient for a second stage by Robinson's method (see technic); if not, the lobectomy may be done at once.

Fifth: Given a patient in good general condition with few adhesions in the chest, with practically none around the diseased lobe, and with the lobe easily removable, the decision to finish the operation at once may be made provided the entire procedure can be finished in half an hour.

Sixth: When in doubt, choose the two-stage method, but remember that the finished lobectomy means the removal of a septic focus and the instant cessation of productive cough.

The Operation.—No one will deny that in any operation unnecessary loss

of time is an evil only. Deliberateness is always justified, but it does not necessarily mean slowness; rash haste must be avoided, but steady progress with little lost motion and with quick decision means safety for the patient.

I have a feeling which is more than a mere impression, that any longer than forty-five minutes used in performing lobectomy means the almost certain loss of the patient. This has been more than once brought to my attention by Doctor Branower, my anæsthetist. Here we have one of the strongest arguments in favor of the two-stage operation, for at the second stage the removal of the sutures and the preparation for lobectomy takes only a few minutes, while the exposure alone in a one-stage lobectomy will occupy from seven to fifteen minutes. Even in suturing these wounds it is better to make a less neat closure than to lose valuable time in perfect approximation. In the checking of hemorrhage, however, there must be no careless haste.

Instead of going over the evolution of the operation as worked out in my cases, I am here describing the procedure as I carry it out at present.

Technic.—The primary incision in the 7th or 8th interspace from just behind the angle of the ribs almost to the costal cartilages should be made through the skin with a free hand. The slant of the ribs in almost all cases is much more oblique than one would imagine. Be sure, then, to keep the fingers of the left hand on the intercostal space so that the line of incision will fall correctly. Now, beginning anteriorly, the muscles are quickly divided, the first assistant taking up the bleeding points and also the uncut vessels which cross the line of incision. The muscles divided are, posteriorly, the lower part of the trapezius, the latissimus dorsi, the serratus magnus. There are formed roughly two layers of muscles, the serratus and the latissimus. The clamping of the vessels should be done quickly, taking in bits of the surrounding muscle rather than picking out the bleeding points too minutely. We now come down to the intercostal tissues and here a short incision is made in the most easily accessible part of the wound, hugging closely the upper border of the rib just below the proposed entrance into the pleura. The anæsthetist is notified that the pleura is about to be opened so that he may be ready with his differential pressure, and with the knife a small pleurotomy is made. There should be no in-and-out rush of air, the pneumatic pressure taking care of this. The pleural opening is lengthened with scissors and the ribs are drawn apart a little by blunt retractors. With strong scissors the pleural opening is rapidly enlarged to the full extent of the incision, when with steady traction the ribs are separated enough to permit the introduction of the blades of the rib-spreader, which in turn are slowly separated until in one or two minutes the widest possible space has been secured. Often six or seven inches separation may be easily obtained, and even without cutting a rib exposure enough for the purpose of the operation may sometimes be had. If the space does not widen sufficiently it is possibly because the posterior intercostal structures require further division. For a lung resection, it is necessary to have a very wide approach, especially when we are dealing with the upper lobe. Then the 7th, or even the 6th space intercostal incision will have to be supplemented by continuing its posterior end upward parallel with the posterior border of the scapula and about one inch or more from it. The rhomboid muscles must be divided and three or four ribs cut through with heavy bone forceps without taking the time to peel away the periosteum. A spinal forceps or a heavy Liston's bone forceps will be found convenient for this purpose and the cutting edge should

be in a plane at right angles with the plane of the rib instead of parallel with it. The cutting is done very slowly so that the intercostal structures are crushed before they are divided, thus minimizing the chance of hemorrhage from the artery. This rib division goes straight through into the pleura. Should there be bleeding from the intercostal when the rib first cut is severed, ignore it and proceed quickly to cut the next rib, at the same time separating the blades of the rib-spreader farther. This will give easy access to the bleeding point. When a sufficient number of ribs have been divided, a second rib-spreader may be placed in the vertical part of the wound; or a single blunt retractor placed anteriorly will draw the ribs forward. This incision is the one devised by Torek in his operation for the transpleural exposure of the thoracic œsophagus.‡

When the operation is to be divided into two stages the making of this vertical part of the wound may be postponed according to the condition of the patient. If during the first spreading of the ribs, particularly in older subjects, a fracture occurs no harm will come of it. The accident is an unusual one. Sharp points should of course be trimmed away.

As soon as the exposure is made, a glance will show the gross pathological relations between the lungs and chest wall, and also the condition of the lung itself. The intermission of the intrapharyngeal pressure will cause the healthy lobe, and in a measure the diseased one, to collapse, indicating the location of adhesions. These are of two kinds; either the broad, dense variety which often signify pus beneath, or the more attenuated, cordlike kind which can easily be divided between catgut ligatures. It is best not to disturb adhesions of presumably healthy lung to chest wall.

The diseased lung may be bluish, brownish or, rarely, pale. It is most often solid and liver-like in feel, and is in sharp contrast with the healthy pulmonary tissue.

If this is to be the first stage only, the healthy, non-adherent lobe and also the costal pleura with which it is normally in contact should be briskly rubbed with gauze and then the lobe should be surrounded with several single layers of iodoformized gauze, about 3 inches wide, placed one beside the other, the ends long enough to reach outside the wound in the chest wall. This employment of gauze to form adhesions I learned in a personal communication from Dr. Samuel Robinson. These pieces of gauze are transfixed in one mass with a safety pin which is left outside the muscular layer of the chest. The place where the safety pin lies should be marked on the skin so that two days later it can be quickly found on the removal of one or two cutaneous sutures. This gauze must be withdrawn in 48 hours. Its extraction is sometimes quite painful, and if the patient is nervous it can be done under light nitrous-oxide anæsthesia. It takes only a few seconds. If it seems desirable the diseased lobe may be surrounded with a large piece of rubber dam to prevent the formation of adhesions. This rubber dam need not be led out at the wound. It is not to be removed until the second stage of the operation. The entire wound is now closed, as will be described in speaking of this stage of the completed operation, excepting that the skin is sutured covering in the gauze, safety pin and all.

One week after the first operation the second stage may be undertaken. By this time firm adhesions will usually have formed between the healthy lung and the thoracic wall, and with the danger of post-operative lung collapse, the danger of mediastinal flapping is also banished. The necessity for differential pressure no longer exists, so that the second stage of the operation, the lobectomy itself, can proceed with the least possible respiratory embarrassment, and even with ordinary inhalation anæsthesia.

‡ The cutting of the intercostal nerves is sometimes followed by pain in their distal distribution. Neuhof has used alcohol injections to combat this.

The Lobectomy itself; Primary or Secondary.—The pulmonary ligament, that fold of the pleura between the pericardium and the lower mesial part of the lung, contains no vessels of importance and it can be quickly divided with scissors. The pedicle of the lobe is now isolated and carefully palpated. In the chronic inflammatory cases this structure is densely infiltrated and its texture is almost that of solid rubber. To separate this pedicle into its elements of bronchus, blood-vessels and nerves would take too long, even if it were possible. Therefore, the pedicle is to be secured with chain ligature sutures of stout, but not too thick silk. In some cases the pedicle can be first crushed with a powerful clamp; in others it is too thick and tough for any clamp, but even here it can be crushed in sections, each section being caught immediately after crushing with a large hæmostatic needle and firmly ligated. The placing of these chain ligatures, taken one next to the other so that no part of the pedicle can escape ligation, is the most important part of the operation; for if one of them slips or breaks there will be such a rush of blood that the vessel lying at the bottom of the opaque pool can never be secured. A large stump should be formed by sectioning the lung tissue, whether diseased or not, an inch or even more distal to the ligatures in the pedicle itself. This should be done slowly with scissors or knife, an assistant wiping away discharge or using suction so that there shall be a minimum spilling from the distal part of the lung. When the ablation is complete the stump must be carefully inspected and all apertures, especially the bronchial openings, wiped out with pure phenol.

Thus far I have assumed that infecting the pleura at the time of operation is unavoidable. Packing off with gauze is only a makeshift and cannot be carried out as it is done in the peritoneum where the viscera have a natural tendency to crowd toward the wound. In the thorax the lung tends to fall away from the wound and infected fluid exudate can hardly fail to become pretty freely disseminated. Following the slow perforation of a lung abscess we often see the formation of sacculated or localized empyema. In the sudden breaking of an abscess, however, a general rapidly forming empyema results; so in these operations when a bronchus or an abscess filled with septic fluid has been entered there is a great gush of pus with immediate extensive soiling of the pleura. Or if there is a protective packing it becomes infected and it is almost impossible to remove it without contact with the pleura. Then, also, it has not been possible actually to sterilize the stump because it is nearly always composed of grossly infected tissue which is supposed to slough off later on. To keep this sloughing stump from the uninfected pleura during the ten to fourteen days before it is cast off appears to me to be at present beyond our skill. The most that we can hope to accomplish is to minimize the soiling so that the invasion of the infection may be slower, permitting the patient sufficient time to acquire resistance.

Following the suggestion of Doctor Neuhof, in some of our cases I have tried to accomplish this temporary protection with the aid of rubber dam. For many years I have made use of rubber dam in my gastro-intestinal work, with great satisfaction. In the lung surgery, however, I have not tested it out sufficiently to know its possibilities. Perhaps if a device can be found for completely isolating the diseased lobe before ligating and ablating it good might be accomplished. I shall continue to experiment along these lines.

The ends of the silk ligatures will have been left long so that they form a bundle of ten or twelve strands that should be tied together with another piece of silk placed so that a large transfixing safety pin will lie upon the chest wall beneath the level of the skin, causing just enough tension upon the pedicle to steady the mediastinum when the patient coughs or strains.

The anterior portions of the cut ribs should now be shortened about an inch

for two reasons: first, to prevent their grating during the early part of convalescence—a disquieting sensation for the patient; and second, to leave room for the bundle of ligatures and for the removal of the stump when it shall have sloughed away. The ligatures and stump are drawn through a hole in the center of a piece of rubber dam which is now slipped down over the stump and embraces what may be called its neck. This rubber dam now forms a sac with the stump at the bottom, and within this sac down to the stump is placed a packing of iodoformized gauze. The rubber dam with the gauze and ligatures in one mass is led out through the upper part of the thoracic wound and marked with a safety pin. In addition to this opening for drainage another smaller one is made through the lower chest wall posteriorly, with or without resection of a small piece of rib; and this opening is made before the closure of the chest and under the guidance of the hand within the thoracic cavity. It should come just above the diaphragm and should be large enough to take a tube of about 28 French. If necessary, a suture of the skin alongside the tube should be made for the sake of airtight fitting. The intrathoracic portion of this tube should have several fenestræ and should be long enough to reach almost to the level of the pedicle (see Fig. 21). The chest is now closed with three or four pericostal sutures of heavy chromicized catgut or kangaroo tendon and one row of chromicized catgut interrupted sutures for each layer of muscle. In closing the chest this muscle suture will be rendered much easier by lowering the bridge and placing the patient's arm down against his side. The drain, rubber dam, etc., with the safety pins is buried beneath the sutured fascia to be removed for drainage on the removal of these sutures in two days.

Under no circumstances, no matter how tempting, should the skin ever be sutured after lung resection for suppuration. The danger of anaërobic infection is great and I have seen more than one patient die of a gas phlegmon beneath what looked like a perfectly clean and innocent cutaneous suture line. The wound in the skin should be packed with iodoformized gauze. In a few days, if all is well, the gauze may be removed and the skin edges strapped.

The tube from the lower part of the chest is clamped after the lobe of lung has been distended by the intrapharyngeal pressure, and as soon as the patient is in bed this tube is carried beneath the surface of antiseptic liquid in a vessel on the floor. Kenyon's drainage.

Dressing.—It has been my rule to forbid an encircling bandage to be placed around the chest immediately after this operation. The gauze is held in place with broad adhesive strips, going not more than two-thirds round the body. These patients must have rest; to encircle the chest with a bandage, gauze, or plaster, means an unnecessary effort with each respiration.

After-Treatment.—Considerable shock usually follows the operation with rapid pulse and respiration. To combat this, morphine in large doses should be administered, regulating the quantity according to the rapidity and character of the breathing and striving to reduce the rate to something under 30. A rapid pulse is not in itself a sign of immediate danger provided its volume remains sufficient, but respiratory distress, either with or without cyanosis, is a cause for alarm.

Transfusion.—After almost every lobectomy there is a large outpouring of bloody serum into the pleura. This serum is intensely stained, looks almost like fluid blood, and I have known it to show as much as 11 per cent. hæmoglobin. Therefore, unless the patient is in exceptionally good condition, with normal blood pressure and hæmoglobin, I think it is well to, as the financiers say, "discount the condition" by a timely blood transfusion. I have usually done this immediately after the operation, and indeed, as I have before stated, I will not prepare for a lobectomy unless the patient has been grouped and the appropriate donor is pres-

ent. If during the operation much blood is lost and the patient is in shock from acute anæmia, a transfusion with citrated blood may be performed because the method is quick and easy. If there is plenty of time, however, I prefer one of the more direct syringe methods instead of the citrated blood. The citrated blood sometimes causes a sharp reaction with chill and hyperpyrexia. In such a grave operation as lobectomy, all the resisting powers of the patient must be conserved, and I feel that in certain of my cases we cannot be sure that the reaction chill did not contribute definitely toward a fatal termination.

After-care and Post-operative Phenomena.—One of the most dangerous complications following an operation upon the lung itself, especially in suppurative cases, is infection by anaërobic organisms. It occurs in nearly every case and often there is a condition greatly resembling the gas gangrene of war wounds. Very little has been done toward the cataloguing of these various organisms. Through research in this field we may hope for the discovery of vaccines which will minimize the risk from infection. On the assumption that anaërobes abhor oxygen, surgeons in the past have made use of the open treatment of infected wounds of other regions, exposing them to the air; and in later days peroxide of hydrogen has been employed. I have frequently used oxygen in open infected thoracic wounds, placing a small catheter in the chest and permitting the gas to bubble through continuously for two or three days, the great size of the wound preventing the danger of tension. I have never considered it proven that this procedure has actually shortened the time of anaërobic infection, but it can do no harm, and when our figures are large enough we may learn more about the value of this form of therapy.

Tension Pneumothorax.—This variety of pneumothorax in which there is progressively increasing pneumatic pressure may occur from within or from without. It usually means that during respiratory effort, whether in breathing, coughing or straining, air enters the pleural cavity which is retained there and prevented from escaping by the valve action of the opening through which it entered. The tension may increase rapidly or slowly according to the amount of air which enters at each cycle, but sooner or later, either in minutes or hours, the pressure becomes so great that the organs of the mediastinum are displaced, that the flow in the veins is impeded, and that respiration gradually becomes impossible. To relieve the condition, it is only necessary to open the tense chamber, equalizing pressure without and within. This had better be done slowly at first so that there may not be too sudden a swinging back of the mediastinum to its normal position. If the pneumothorax is general, relief may be had by opening a part of the wound. If it is sacculated and cannot be reached by way of the wound, puncture should be made through the unopened part of the chest where the physical signs indicate the trouble. A fine trocar and cannula is the proper instrument, and with the aid of an attached rubber tube, its end under water, the bubbling of the escaping air may be observed. If it is desired to secure a negative pressure within the chest, the patient should be requested to strain repeatedly, the

tube being pinched with each inspiration until no more bubbles appear on expiration; then the needle should be quickly withdrawn. What we have accomplished can often be determined by means of the X-ray. The relief afforded is striking. A tension pneumothorax may overflow into the external tissues or into the mediastinum through small openings, causing subcutaneous or mediastinal emphysema; and if this becomes in itself alarming it can be relieved by suction with a cupping glass, or Bier's apparatus, through incisions in the skin. Another danger of this pneumatic tension in the thorax is air embolism.

For the first twenty-four hours after the initial reaction following the operation, there is little to do. The patient seems surprisingly well and breathes easily. Any sudden dyspnœa in this period would probably signify the slipping of a bronchus from its ligature and a tension pneumothorax.

Hemorrhage will be recognized by the classic signs.

In forty-eight hours the wound should be inspected, and in not more than three days the muscle sutures covering the ligature bundle are removed and this part of the wound examined. The gauze within the rubber bag is loosened, but should not be removed unless it comes away with great ease. The lower drainage tube is cut off short and secured with a pin in the usual manner. Anaërobic infection with its gangrenous stench becomes evident. There may be some marginal sloughing. This foul odor will persist until the stump comes away—in ten to eighteen days, occasionally still longer. Then the bronchial fistulæ will appear with their whistling which often annoys or alarms the patient. Rarely, even at this date, there may be distress from mediastinal motion which can be relieved by an occlusive wet dressing. The chest being now wide open, the danger of tension pneumothorax is past. Rarely tension pneumothorax may even then occur as a sacculated form behind adhesions.

Gradually granulation sets in and the wound heals down to two fistulæ, one above, and the other where the tube is. The upper wound may be permitted to close as soon as it will, but the lower should be kept open until it has become a mere track, when the tube may be removed, the bronchial fistulæ having usually closed by this time. Dakin's fluid cannot be used with safety in these chest wounds with their wide-open bronchi. Yet an aseptic pneumothorax may form and the X-ray may reveal this condition months after the patient has fully recovered.

In nearly all my cases there have been occasional slight hæmoptyses weeks or even months after complete external healing has taken place. I have never had one of these patients bronchoscoped, but I believe that the source of the bleeding is probably granulation tissue at the site of the closed bronchus. These hæmoptyses have never been serious, and it is my custom to warn each patient when he is discharged that he may expect occasional slight blood spitting. Otherwise he is apt to become panic-stricken and to feel that his case is a failure. There is no fever, and I have never found it necessary to demand even rest in bed when such a little hæmoptysis occurs, but I do advise

a radiographic examination. Thus far, no patient who has shown this symptom has developed any recurrence or other serious complication in consequence.

A day or two after the safe sloughing off of the stump, the patient may sit out of bed. He will not be actually healed, however, short of two or three months, and cannot be considered well for a much longer time. I have seen moderate cough at intervals even with a little sputum for the greater part of a year, yet with complete final recovery. In most of the cases, during the period of healing and until the wound is entirely closed, it has been found that the slightest disturbance in the patient's general condition has been followed by a rise of temperature. Even a little unusual exercise has been followed by slight fever as in tuberculosis. The greatest patience and attention to detail, with frequent visits of the surgeon, are necessary to success. And above all price is a tried and experienced nurse.

I have carefully read what Sauerbruch has to say on suppurative bronchiectasis in his 1920 work on thoracic surgery—a scholarly and beautifully made book. As to the merit of his methods of treatment, however, including his technic of lobectomy, I am far from convinced. Persistent bronchial fistulæ, deforming thoracoplasties, probably no patient actually cured—these results do not appeal to me. It would almost be better not to try to do a radical operation. He reports (*loc. cit.*, pp. 588–589) three cases of lobectomy for bronchiectasis based on animal experiments. The operations were done through intercostal incisions, the vessels of the pedicle were ligated, and the bronchi were closed by ligature and inversion. The chest was closed without drainage. No wonder all three patients expired from tension pneumothorax six days later. The same results followed a case similarly treated by Friedrich. Sauerbruch, from his experience, rashly concludes that one-stage lobectomy should be abandoned. He might, perhaps, have saved all three of his patients by a more surgical technic. These cases cannot be treated by attempting permanent closure of the bronchi at the time of resection, as might be feasible in the aseptic cases, such as the removal of tumor-bearing portions of lung. In the suppurations the bronchi will surely reopen a few days after operation, and this should be expected and provided for.

Sauerbruch also (*loc. cit.*) extirpated a lobe in nine other cases by the many-stage method. *There were no cures,* five were considerably improved, two were slightly improved, and two died. Again he reaches the unwarranted conclusion that a cure in the true sense of the word cannot be accomplished.

Robinson's technic is founded on correct surgical principles and promises good results. Its outstanding disadvantage is the approach by rib resection which leaves an unnecessary degree of contracting deformity. Some contraction of the chest is unavoidable after the removal of an entire lobe, but much of the dead space should be filled by the other lobe which becomes hypertrophic, and perhaps what might be called physiologically emphysematous, and also by the compensatory raising of the diaphragm on the same

side. The surgeon need not provide for this filling of space for Nature is able to take care of it.

Post-mortem Examinations.—Even when an operation through an ample incision has made us believe that we have noted all gross pathological conditions relating directly to the operative part of the case, a carefully performed autopsy will often bring out unrecognized or even unsuspected facts from which much can be learned. Through a so-called " wound inspection," when the opening has been large enough, an almost complete autopsy may be performed. It omits, however, the cerebrospinal system, in which secondary or metastatic foci are peculiarly apt to appear in pulmonary operations.

We have been recently especially fortunate at Mt. Sinai Hospital in having for our assistant-director, Dr. E. M. Bluestone. He comes in contact with the families of the patients and he has the necessary tact to deal with the situation so that through him we have secured 80 per cent. of autopsies. His example may well be called to the attention of those in charge of similar institutions.

Cases of resection of the lung for suppurative disease are the most trying ones in all surgery. The high mortality, the sudden and often disappointing changes, the repeated crises, the numerous complications, and the prolonged convalescence with no feeling of security until long after the wound is healed, would hardly be worth the tremendous effort were it not for the unequalled gratification in the final success. To have been the instrument of restoring one of these wretched beings to blooming health after months or years of revolting illness with the constant fear of fatal pulmonary hemorrhage is the richest reward that surgery can offer.

CONCLUSIONS

1. Chronic pulmonary suppurations wholly or partially of the bronchiectatic type are rarely curable without the extirpation of the pathological focus.

2. The surgical removal of a single pulmonary lobe for chronic pus infection has a mortality of about 42 per cent. The danger is much greater when more than one lobe is infected or in the presence of other complications.

3. Remissions of weeks or even months may occur spontaneously.

4. Palliative operations may be followed by improvement, rarely by apparent cures.

5. The commonest cause of the disease is infection due to the aspiration of infected material during tonsillectomy.

6. Radical operation should not be undertaken short of several months after the onset unless the disease is obviously spreading.

7. The proper type of operation should be determined only on full exposure by thoracotomy.

Here are brief abstracts of the histories of all my patients. All have been followed up to date except Case No. 14 (David J.), who was followed for two years, and at last account was well. Pathological study of all speci-

mens has been made by Dr. Paul W. Aschner, Adjunct Surgeon and Assistant in Pathology, Mt. Sinai Hospital, and the results are here reported by him. It is most interesting that in going over the material together, the histological findings placed the cases in the same group in which they had been put by me immediately after operation. The literature was searched by Dr. S. Hirshfeld who furnishes references and brief abstracts of interest.

CASE I.—*Suppurative Bronchiectasis Following Tonsillectomy; Lobectomy; Middle Lobe.* This case has been reported in the ANNALS OF SURGERY for July, 1916. The following is a brief abstract:

Mrs. Elizabeth M. B., age thirty-three, came to me twenty-two months after her tonsillectomy in general anæsthesia. Characteristic symptoms of lung abscess had appeared ten days later. When I saw her in October, 1915, I found her general nutrition good in spite of frequent attacks of fever. There was clubbing of the finger tips and a productive cough with as much as a quart of stinking secretion in twenty-four hours.

Operation.—On October 18, 1915, in nitrous oxide, oxygen and ether administered by Doctor Branower, in a little less than an hour the middle lobe was extirpated. Loss of blood slight. Pulse after operation 140.

Post-operative Course.—The day following the operation there was considerable shock, respirations up to 60, pulse 144. This was probably owing to the accidental omission of morphine during the night. Almost immediately after giving a hypodermic of one-fifth grain of morphine and one-two hundredth grain of atropine the respirations dropped to 30 and the pulse to 120. This medication was repeated every four hours. The usual bronchial fistula appeared, but closed spontaneously and the patient was discharged well on December 20, 1915. A few times after her discharge there were slight hæmoptyses, but the patient may be considered perfectly well and leads a normal life.

CASE II.—*Lung Abscess Following Tonsillectomy—Resection of the Left Upper Lobe.* Mrs. C. M., twenty-eight years old, came to me July 10, 1917. Tonsillectomy in general anæsthesia had been performed about April 1, 1917. The operation was difficult owing to the friability of the tissue and it lasted about three-quarters of an hour. Ten days later there was cough followed by profuse, foul, purulent expectoration. When I first saw her she was coughing twelve ounces of foul mucopus a day and three days before there had been an hæmoptysis of about eight ounces.

X-ray examination in the recumbent position resulted in a diagnosis of single abscess in the left upper lobe. After the patient had entered the hospital, however, a second X-ray examination was made in the upright position and another with the patient lying on her sound side. These showed "a dense infiltration which extends from the left apex down to the level of the third rib anteriorly, involving approximately the left upper lobe. This has the appearance of a pneumonic consolidation. Just beneath the middle of the left clavicle there is an oval cavity about one and one-half inches in diameter which is half-filled with fluid. It shows a fluid level which shifts on change of position. The heart is somewhat displaced toward the right. The remainder of both lungs appears to be uninvolved" (Wessler).

In this case, on account of the tendency to hemorrhage, it was decided to dispense with bronchoscopy and to proceed at once with the surgical therapy.

Operation.—Operation was undertaken on the inauspicious day of Friday, the thirteenth, in July, 1917, in the Private Pavilion of Mt. Sinai Hospital, Dr. Martin W. Ware and Dr. A. O. Wilensky assisting. The anæsthetic, given by

the intrapharyngeal method, was ether and oxygen administered by Doctor Branower. A preliminary ligation of the upper part of the thighs reduced the systolic blood pressure from 125 to 115 by blood segregation. A long incision was made at the sixth interspace with removal of six or seven inches of the sixth rib with its periosteum. The sixth, fifth and fourth ribs were divided near their angles through an incision carried upward along the border of the scapula. A rib-spreader was put in. No adhesions were encountered in the lower chest, but upper and lower lobes were adherent to each other and the lower lobe slightly adherent to the posterior chest wall. The abscess was quickly identified by the dark color and liver-like consistency of the lung. A small abscess was entered in peeling away the lower from the upper lobe, and going a little further the main abscess was entered and found to be much larger than would have been judged by the X-ray, much of the opacity having been due to the presence of pus without air and also to the great density of the surrounding infiltrated pulmonary tissue. Most of the adhesions between the upper lobe and the parietes were easily broken down, but a few had to be ligated. The upper lobe was nicely mobilized and its apex found to be apparently healthy. The main abscess, which was now widely opened, was disinfected with phenol, and all inflamed and infected tissue was excised between ligatures of chromicized catgut. Hemorrhage was not great but the blood-pressure during the operation gradually fell to about 60, even after both ligatures had been removed from the thighs, letting in the segregated blood. The diseased part having been removed Doctor Branower was able to demonstrate the permeability of the bronchi to the upper and lower lobes by inflating them with his intrapharyngeal apparatus. Other suture ligatures were placed around small parts of the uninvolved upper lobe and were sutured to the chest wall in order to steady the mediastinum. The stump was also sutured to the parietal wound and its hollow packed with iodoformized gauze. At the ninth interspace posteriorly a small incision was made into the thorax and a rubber drainage tube fastened there airtight. The wound was now closed throughout by muscular and then cutaneous sutures in such a way as to close the chest, entirely burying the tube, gauze and drainage material. This was done so as to make respiration easier for the first forty-eight hours, when it was intended to reopen the suture line at suitable points for drainage.

Post-operative Course.—Following the operation there were many days of anxiety. The respirations, however, averaged only about thirty-eight and the pulse about 134. Four days after the operation the anterior part of the wound had to be reopened to drain the thoracic wall, which was filled with foul pus, the product of infection by anaërobic organisms. There was also some subcutaneous crackling on palpation. The thorax had been opened for drainage two days before and more than twenty ounces of intensely bloody serum evacuated. This serum measured up to ten per cent. in hæmoglobin but there were no clots. Because of the anaërobic character of the infection I passed oxygen through the chest for several days by attaching a drainage tube to the oxygen tank and permitting the gas to flow through at the rate of about two bubbles a second. Eight days after operating the packings were removed from the upper part of the chest and this was followed by slight, though annoying, cough which continued in scattered paroxysms for four more days, when a bronchial fistula appeared and the cough ceased. There was continued general improvement, however, and the patient sat out of bed for the first time twelve days after the operation, although she was still very weak. The pulse was 120, the temperature running to 101 and the respirations to thirty. About four weeks post-operative the healing process had divided the chest into two distinct chambers, an upper and a lower one. The upper discharged foul pus, the lower non-odorous. The upper wound was packed daily with iodoformized gauze. The ligatures came away about three weeks

after the operation, carrying with them a large pulmonary slough, and there was an immediate change for the better. Anaërobic infection, subcutaneous in character, appeared and the anterior part of the wound had to be opened. This pocket was in the chest wall only. It was quickly disinfected and healed nicely under the Carrel-Dakin treatment. The pulse at this time was usually below 100, respirations about twenty and temperature in the neighborhood of 100½° to 98.4° and the patient was walking about.

Mrs. M. was discharged from the hospital the latter part of August with a tiny thoracic fistula from the lower drainage opening. It soon closed spontaneously and has remained closed.

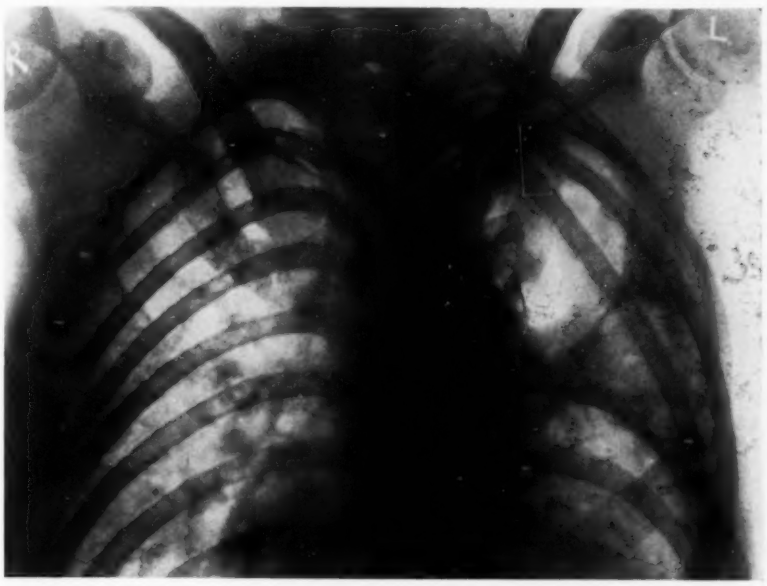

FIG. 1.—Case 2. Mrs. C. M. Resection of left upper lobe, four years after operation. Patient well, all wounds closed for nearly four years. Function of arm and shoulder perfect. Small aseptic pneumothorax. Upper ribs contracting upper part of chest. Bridge of new bone connecting rib stumps.

For more than a year there were occasional exacerbations with cough and slight expectoration, not foul in character. Each of these appeared as the result of a "cold" and finally ceased altogether. Recently this patient went through a severe typhoid fever with intestinal hemorrhage, for which a blood transfusion had been necessary. There was also a little cough, and her physician, Doctor Hanan, feared that the cicatrix in the lung might be breaking down. An X-ray examination was made. The lung did not necrose, however, and the patient made a splendid recovery from her typhoid and is well at the present time with no indications of active thoracic disease. (See Fig. 1.)

CASE III.—*Bronchiectatic Lung Abscess Following Tonsillectomy—Sub-total Pneumectomy.* This case has been reported in Surgery, Gynecology and Obstetrics for November, 1919. A brief abstract follows.

W. A. B., a man twenty-six years old, had had his tonsils removed in general anæsthesia and there developed a suppurative bronchiectasis with abscesses of the right lower lobe, the middle lobe and part of the upper lobe. I first saw him fifteen months later, on March 14, 1917, in the private ward of Mount Sinai Hospital. The case had been steadily progressive, the first symptoms appearing

about a week after his operation. At my first examination this patient looked almost moribund. His temperature was 104° and his appearance was that of a person in the last stages of tuberculosis. I hesitated to operate. He and his family, however, begged for relief and were willing to accept almost the worst possible prognosis if only something could be done, for it was recognized that he would die perhaps in a few days longer.

The X-ray examination showed lung involvement from the second rib down to the base where the diaphragm was drawn up by adhesions. There were a number of cavities with fluid levels. The left chest was apparently normal. In spite of the long duration of his illness there was but little clubbing of the fingers. Blood-pressure was 100 over 65.

FIG. 2.—Case 6. Miss J. K. Preoperative. See history. Upper and lower lobe disease.

On March 16th, Doctor Yankauer bronchoscoped the patient in general anæsthesia with nitrous oxide and ether and I was in hopes that it might be possible to wash out some of the pus prior to operation. Owing to the patient's wretched condition this attempt had to be abandoned but the procedure consumed about fifteen minutes. I then operated, Doctor Branower continuing the anæsthesia and Doctor Ware assisting at the wound. The thighs were ligated with elastic ligatures to segregate the blood during operation.

Operation.—A long seventh interspace incision was made with resection of the greater part of the seventh rib and section of the sixth rib posteriorly. The chest contained straw-colored fluid and covering a part of the posterior portion of the upper lobe there was a coating of lymph. In peeling away the lower from the upper lobe a large abscess cavity was entered. The lower and middle lobes were removed beyond mass ligatures of chromicized catgut and heavy silk. Very little hemorrhage occurred. The chest was temporarily closed with drainage after about a pint of paraffin oil had been poured into the thoracic cavity and left there. The stump was carbolized and iodoformized gauze placed against it. Immediately after operation 500 c.c. of citrated blood were transfused by Doctor Wilensky. A gangrenous condition of the wound developed and it had to be

opened widely. Oxygen in a slow stream was passed through the thoracic cavity for two days but without appearing to influence the anaërobic infection. The wound was then packed lightly with iodoformized gauze and improvement followed. With the chest wide open it was seen that we had evidently included much—if not all—of the pedicle of the upper lobe in the ligatures and that this upper lobe had so far contracted that it could not be seen. The usual bronchial fistulæ formed, but gradually the patient picked up and was finally sent to his home with a thoracic sinus which I feared to permit to close on account of the open bronchi. It closed spontaneously, however, and the patient was shown before the American Society for Thoracic Surgery at its meeting in Atlantic City on June 9, 1919, apparently entirely well and with the thorax firmly closed. The general condition was excellent. He was working and said that he could exercise without undue fatigue and mentioned particularly that he had danced seventeen

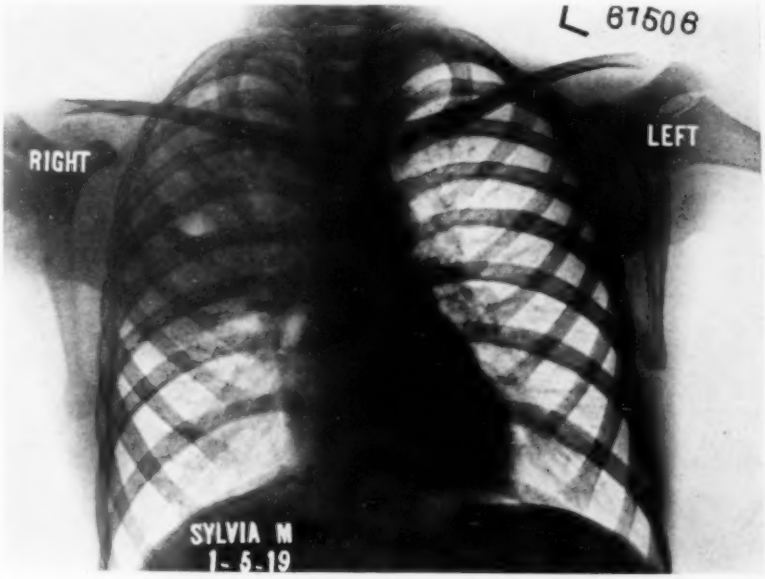

FIG. 3.—Case 7. Sylvia M. Preoperative. Right upper lobe bronchiectasis with cavitation.

dances in succession without distress. Since that time the wound reopened twice and the patient, who is very intelligent, preferred the presence of a small tube in his thoracic sinus rather than the annoyance of the occasional fillings. The discharge is very slight and the patient with this exception may be considered entirely well. He has married twice since his operation.

CASE IV.—*Post-Tonsillectomy Lung Abscess (Bronchiectatic)—Two-stage Lobectomy—Death.* Miss S. K., sixteen years old, was admitted to the Medical Service at Mount Sinai Hospital on May 7, 1917. About April 15th of the same year tonsillectomy in general anæsthesia had been performed and there developed fever, cough, pain in the chest and purulent expectoration.

X-ray examination showed a cavity two inches in diameter in the right lower lobe with a beautifully marked fluid level.

Under medical treatment this cavity became much smaller, the symptoms were relieved and the patient was discharged on April 10th and sent to the country. A month later she was readmitted to Doctor Manges' service with her symptoms just as bad as ever. She was transferred to me on June 3rd and I

operated the same day in local anæsthesia. An abscess was found in the upper part of the right lower lobe. Adhesions were separated but nothing further was done.

June 6th, the patient going down-hill rather rapidly, I removed the right lower lobe, and during the operation she received 600 c c. of blood by the citrate method. She died two hours after the operation.

The specimen showed an abscess one and one-half inches in diameter in the right lower lobe.

CASE V.—*Bronchiectatic Lung Abscesses Following Tonsillectomy—Extirpation of Right Upper and Middle Lobes—Death.* Miss E. B., thirty-three years old, was brought to me on July 11, 1917, by her physician, Doctor Chappell, of Middletown, N. Y. About two years before her tonsils had been extirpated under general anæsthesia, and thirteen days later there was cough with foul

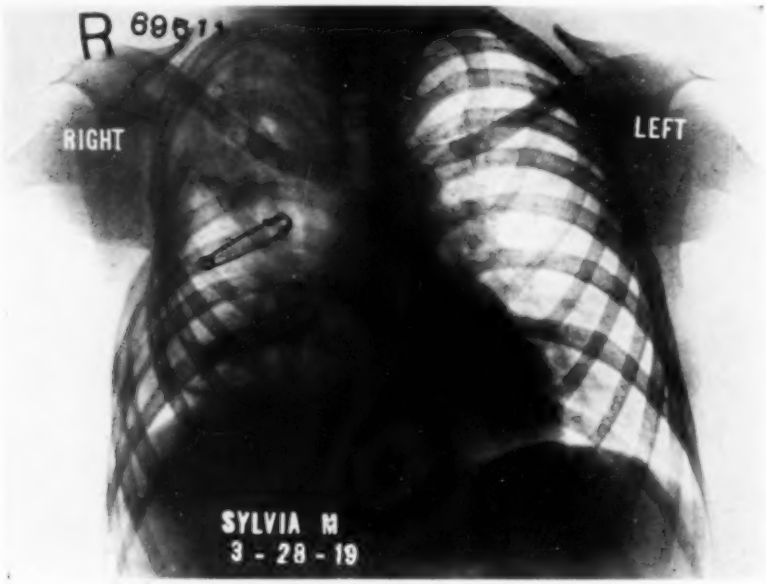

FIG. 4.—Case 7. Same patient, 38 days after operation. At the present writing chest is clear.

expectoration and fever. Thereafter with brief periods of remission the symptoms had been practically unchanged. Her temperature ranged between 100° and 105°. She stated that she sometimes expectorated as much as one and one-half pints during one emptying. There were repeated hæmoptyses. The fever in this case was high during the periods of greatest expectoration.

The X-ray showed apparently an abscess of the middle lobe.

This patient had been at Saranac Lake, although no tubercle bacilli had been found. The other lung was healthy.

Bacteriological examination showed the continuous presence of streptococcus. After admission to Mount Sinai another X-ray picture was made and Doctor Wessler reported abscess of the upper lobe.

Because of the unbearable condition, together with the danger from frequent hæmoptyses, I decided to operate. The patient entered the Private Pavilion of Mount Sinai Hospital, and on July 17th in nitrous oxide and ether anæsthesia by Doctor Branower (intrapharyngeal method) I operated. Doctor Ware and

Doctor Wilensky assisted at the operation. Blood segregation had been secured by means of elastic ligatures placed about the thighs.

Operation.—A long sixth interspace incision was made and a long piece of the seventh rib was at once resected. The fourth and fifth ribs were then divided posteriorly. It was at once seen that although the lower lobe was apparently healthy the middle and upper lobes were diseased. They were dusky and hard to the touch, expanding and contracting little with respirations. There were numerous dense adhesions above but none below. In one mass the upper and middle lobes were ablated beyond ligatures of chromicized catgut with two of silk. Hemorrhage was inconsiderable but the patient's condition was poor, although the systolic pressure did not go below eighty. It had been 125 before operation. The stump was carbolized and fastened to the chest wall. A counter-incision in the ninth interspace behind was made for drainage and the wound was temporarily closed without drainage. She received 300 c.c. of citrated blood. There was cyanosis but no embarrassment of respiration. Six hours after operation the condition appeared good, the pulse was 160, but of fair quality. Fifteen hours after operation, however, there came a change for the worse, with cyanosis and weak and rapid pulse. One hundred and fifty c.c. of citrated blood which had been saved from the first transfusion were now put in. The patient did not rally, and died thirty-one hours after the completion of the operation with a sharp rise of temperature to 105°. No autopsy permitted.

Case VI.—*Bronchiectatic Lung Abscesses of Upper and Lower Lobes following Tonsillectomy. Extirpation of Lower Abscess.*—Miss J. K., thirty-two years old, was sent to me on September 8, 1917, by Doctor Waring, of Denver. Tonsillectomy had been performed three years before in general anæsthesia. The tonsils were imbedded and the operation difficult. Thirteen days later there appeared cough, fever and the other usual signs of lung abscess. The fever became remittent with attacks every two or three months accompanied by foul expectoration. There was clubbing of the fingers. No tubercle bacilli were found upon repeated examination. Patient's general condition appeared to be good and there was no organic disease other than that mentioned.

X-ray pictures taken in Denver and retaken by Doctor Wessler in New York, showed what appeared to be an abscess near the hilum of the middle lobe partly involving the upper. Adhesions to diaphragm were evident. (See Fig. 2.)

The patient had been unable to work for three years and both she and her family were willing to take the chance of an operation.

She entered the ward of Mount Sinai Hospital, and on September 20, 1917, I operated. Intrapharyngeal anæsthesia by Doctor Branower. Segregation of blood was attained by ligation of the thighs. The blood-pressure before operation was 122 systolic, 88 diastolic.

Operation.—A sixth interspace incision was made and large parts of the seventh, sixth and fifth ribs were resected posteriorly. The rib-spreader was put in and it was then found that the middle lobe was the only one of the three which was absolutely unaffected. In the lower lobe a dense abscess was adherent to the posterior chest wall near the spine and there was another in the upper lobe. The two lobes, however, could be easily separated by loosening the attenuated adhesions. General adhesions about the upper lobe held it to the chest wall so that it did not collapse. The adhesions to the diaphragm were now cut loose and the abscess of the lower lobe was extirpated in the usual manner with chain ligatures of chromicized catgut. Soon after the operation began the blood-pressure commenced to drop and the ligature about one thigh was loosened. Even after this, however, the blood-pressure was under eighty. The operation up to this point had been quickly done, but it was decided not to disturb the upper lobe abscess at that time, the patient's condition not warranting it. Because of the

adhesions of the upper lobe there was little danger of mediastinal flapping; however, the ligatures were all left long and fastened to the chest wall. The wound was closed by muscular and cutaneous suture with drainage anteriorly and large drainage posteriorly with gauze down to the abscess stump. A third small incision was made low down posteriorly to make sure of good drainage by tube. Hemorrhage was slight.

Eight hours post-operative the patient's condition was good; the pulse was 120 and respirations were forty. After that, however, there was rapid deterioration of the heart action with weakness and irregularity, although the rate did not go higher than 160. There was much cough with expectoration of very foul pus, evidently from the abscess of the upper lobe. Twenty-four hours post-operative because of the progressive cardiac failure, a transfusion of 360 c.c. of citrated blood was made, but she continued to lose ground and a few hours more death occurred.

FIG. 5.—Case 7. Patient well, showing use of arm.

CASE VII.—*Chronic Bronchiectatic Abscess of Right Upper Lobe Following Tonsillectomy.* Sylvia M., eight and one-half years old, was admitted to the Medical Service of Mount Sinai Hospital on January 23, 1919. Temperature, 105°; pulse, 140; respirations, forty. Nine months before tonsillectomy had been performed in general anæsthesia and about two weeks later there was coughing with foul expectoration and irregular fever. Four weeks before admission the child had spit a little blood and there were occasional night sweats.

Physical examination showed the right tonsil absent. In the right lung from the apex to the second rib were signs of cavitation, while there were many fine moist râles over the entire upper lobe. Urine negative. Fingers clubbed. Blood showed 17,600 white cells with ninety-seven per cent. polymorphonuclears, twenty-one lymphocytes and two eosinophiles. Hæmoglobin sixty per cent. Blood-pressure 95–65.

X-ray examination showed dense consolidation of the right upper lobe in the centre of which was a circular cavity an inch in diameter at the level of the second space anteriorly.

On February 17th the chest was punctured with a small trocar and cannula below the diseased part in presumably normal pleura with the idea of admitting air so that a subsequent radiograph would show the character and location of adhesions. This examination was satisfactory and indicated that there were no

general adhesions in the upper part of the chest. The diseased area was much more easily seen than before the air had been admitted.

Operation.—On February 18, 1919, in intrapharyngeal gas and ether anæsthesia by Doctor Branower, a seventh interspace incision was made and carried upward posteriorly parallel with the scapula. Small sections of the sixth and fifth ribs were removed. Rib-spreader exposure. There were a few adhesions at the apex, one of which required ligation. A dense adhesion between the upper and lower lobes posteriorly was also ligated and divided. Other adhesions were broken down digitally. The upper lobe was then removed beyond serial chromicized catgut suture-ligatures. A separate drainage opening was made in the lower part of the chest posteriorly into which a tube was inserted to the dead space above. Through the upper posterior wound a small gauze packing was led down to the carbolized stump and then both wounds were sutured, closing the entire chest—skin and all.

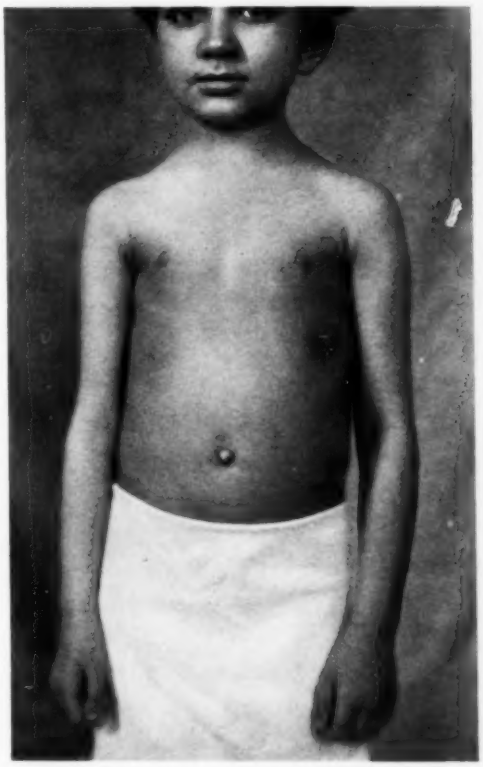

FIG. 6.—Case 7. Patient well, showing symmetry.

Post-operative Course.—Immediately after the operation, although the patient's general condition was excellent, 200 c.c. of citrated blood were infused intravenously. Morphine and codein were ordered in sufficient quantities to keep the respirations below thirty-five and tincture of digitalis five mm. was ordered every six hours for two days. The respirations had been sixty immediately after the operation but were reduced by the medication to twenty-six. Reaction temperature to 105° dropped to 101°. Pulse immediately after operation 160, but in twenty-four hours the rate was 120. Patient's morale excellent.

Forty-eight hours after operation the drainage openings were exposed. There was no great tension within the chest and comparatively little fluid. The lower tube did not drain satisfactorily. The gauze was removed from the upper opening and there escaped several ounces of foul thin fluid. Since the lower drain was unsatisfactory a tube of large calibre was inserted through the posterior part of the upper wound and the foot of the bed was elevated. On March 3rd the temperature began to mount slowly and five days later it reached 104° and there was rapid pulse and general deterioration. X-ray examination was not helpful but retention was suspected, and on withdrawing the lower tube a few drops of thick pus escaped. Therefore in gas and oxygen anæsthesia the adjoining rib was resected and the chest explored with the finger. No pus, however, was

encountered and the tube was replaced. This operation was not followed by relief, but twenty-four hours later there was a sudden discharge of a quantity of pus from the upper wound and the patient's condition became critical. March 19th, after a stormy period, the little girl was considered out of danger. On April 21st she was discharged well, having gained much in weight and with perfect function of the arm. The case has been followed up carefully and recovery seems to have been perfect. (Figs. 3–6.)

CASE VIII.—*Bronchiectatic Lung Abscess—Post-tonsillectomy. Pneumectomy —Death.* Rose F., twelve years old, had her tonsils removed in gas anæsthesia in August, 1918. About two weeks later the usual symptom complex of bronchiectatic lung abscess appeared. I first saw her as a patient on the medical side of Mount Sinai Hospital in February, 1919.

Preoperative Condition.—There was clubbing of the fingers and toes, periods of high fever with remission and much coughing with copious expectoration of foul mucopus. The right lung was much contracted; the right diaphragm was adherent and drawn upward. The progress of this condition was followed up by means of X-ray study, which clearly indicated a steady extension of the disease. (Figs. 7–11.)

On February 28, 1919, I operated; Doctor Branower administered the anæsthesia (gas, oxygen and ether).

Operation.—A long seventh interspace incision with resection of the seventh, sixth and fifth ribs posteriorly. The skin wound was extended vertically to permit of rib sections. There were numerous adhesions to the chest wall, the posterior ones being very dense. The entire right lung was hopelessly diseased and it was removed by the chain ligature method, each part ligated being previously clamped. Toward the end of the operation, on lifting the lung outward, a sudden hemorrhage occurred from a large vein. The opening in the vein was secured with clamps, which were left in place, owing to the patient's desperate condition. Citrated blood transfusion was immediately performed and the wound was partly closed by suture. The patient left the table with a rapid but easily countable pulse, but she died six hours later, apparently from œdema of the opposite lung. The specimen showed extensive suppurative bronchiectasis throughout the greater part of the right lung.

CASE IX.—*Abscess of Lung Following Tonsillectomy—Partial Extirpation and Drainage—Death.* I first saw Mrs. J. P. in the Private Pavilion of Mount Sinai Hospital on March 16, 1919. About five years before she had had her tonsils removed in general anæsthesia and the usual symptoms of lung abscess appeared about two weeks following the operation. There had been a gradual progression of the symptoms with occasional small hæmoptyses, expectoration of about ten ounces of pus per day and pain in the left chest. The abscess was opened about a year following her tonsillectomy in a two-stage operation with resection of the eighth rib posteriorly and suture of the lung to the parietal pleura followed by opening and drainage of an abscess. She was unrelieved.

On my examination I found a frail, little woman, thirty years old, with clubbing of the fingers, fetid breath and signs pointing to consolidation posteriorly in the left chest. The temperature was 100°. The urine was normal. Blood-pressure was 130. The heart action was normal as to strength but was not regular.

X-ray examination by Doctor Wessler demonstrated a shadow, presumably a lung abscess of large size, either in the lower part of the upper lobe or the upper part of the lower lobe.

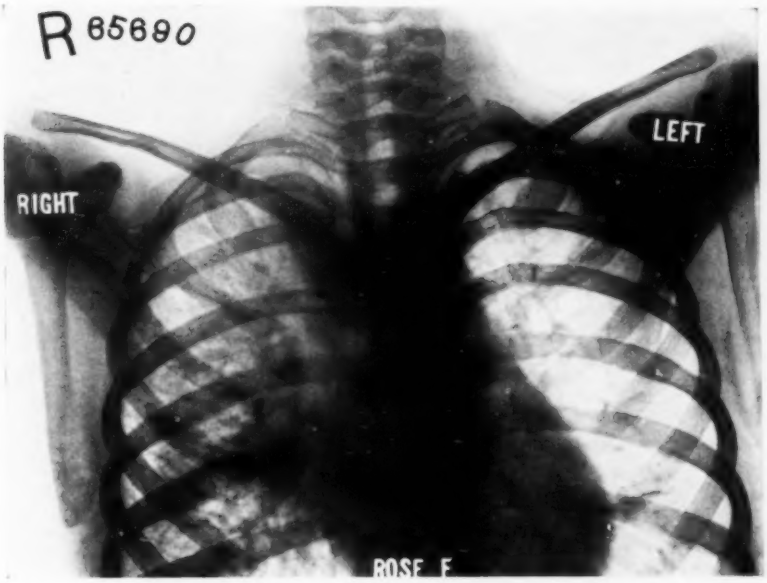

FIG. 7.—Case 8. Rose F. These five pictures taken at intervals during three months show progress of the disease. Operation should have been performed earlier.

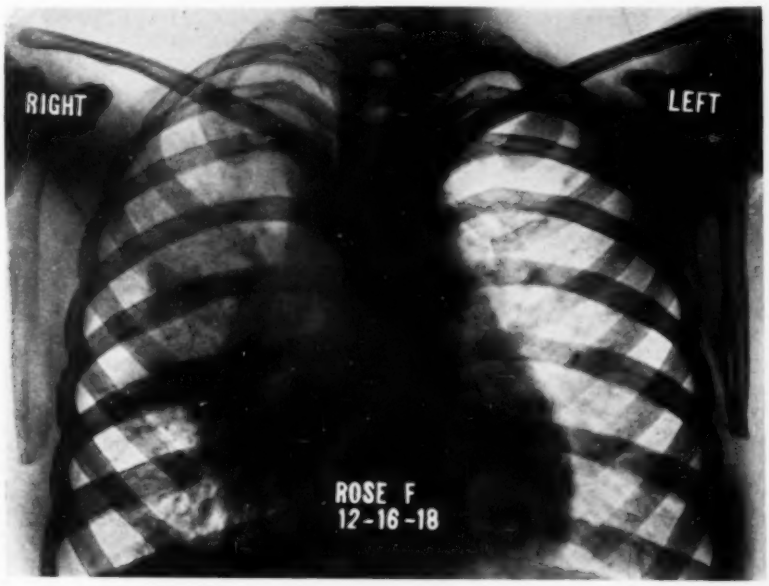

FIG. 8.—See legend on Fig. 7.

Digitalis stimulation was administered for the twenty-four hours before operation. On March 29th I operated, Dr. Martin Ware assisting, anæsthesia by Doctor Branower.

Operation.—An incision was made above the old scar with a long resection of the seventh rib and division of the sixth and fifth ribs posteriorly. There were

numerous adhesions, particularly at the site of the old operation, and they were divided between ligatures. Both lobes were involved posteriorly and the posterior wall of the large abscess, containing putty-like, extremely foul, inspissated pus, was resected. The remainder of the abscess wall was sponged out with carbolic and packed with iodoformized gauze. The wound was closed with pericostal sutures, suture of the muscles and suture of the greater part of the skin. A wet gauze dressing was applied and retained by adhesive strips placed so as not to confine the opposite chest. During the latter part of the operation the patient's blood-pressure fell to seventy-five and immediately more than 400 c.c. of citrated blood were transfused.

Post-operative Course.—The patient's condition at the end of the operation was apparently good; her pulse, however, became weaker in spite of the fact that there was no hemorrhage, and more rapid, and death occurred twelve hours after completion of the operation.

CASE X.—*Bronchiectatic Lung Abscess Following Tonsillectomy—Lobectomy.* M. V., age fourteen, had had her tonsils removed in general anæsthesia in August, 1919. Diphtheria was said to have followed this operation and the patient was treated with antitoxin. About four weeks later there began cough and symptoms of progressive lung suppuration with fever and putrid expectoration. A radiograph by Dr. James A. Miller, to whom she had been taken by her physician, Doctor La Fetra, showed a shadow at about the middle of the right chest which apparently indicated pulmonary suppuration either in the middle lobe or upper part of the lower lobe.

I saw her first on February 12, 1920, at the Park Hospital. I found a well-nourished child who was running a temperature up to 104° and who expectorated large quantities of extremely foul pus.

She entered the Private Pavilion of Mount Sinai on February 19, 1920, where another X-ray picture showed opacity of the lower two-thirds of the chest, completely obliterating the original abscess shadow. Aspiration with large needle was performed on February 20, 1920, with the idea that an empyema existed also. No pus was obtained, however. As the needle was withdrawn, a small quantity of two per cent. lysol solution was injected into the tract to prevent, if possible, infection of the chest wall.

The same day she expectorated an enormous quantity of pus, which was blood-stained, but another X-ray failed to show any change in spite of this emptying.

On February 21, 1920, in gas and oxygen anæsthesia by Doctor Branower, Doctor Aschner assisting, I operated.

Operation.—A long seventh interspace incision was made with resection of a small piece of the posterior part of the seventh rib, and rib-spreader exploration was done. Dense adhesions existed posteriorly between the dark red solidified lower lobe and the chest wall. The middle and upper lobes looked normal, but the upper lobe was adherent posteriorly. There was no adhesion between the lower lobe and the diaphragm. With the intention of performing a lobectomy at another sitting, gauze packings were placed between the upper lobe and the chest wall to cause adhesions here and a piece of rubber dam was laid between the middle and lower lobes to prevent adhesions in this part. The wound was then closed with two kangaroo-tendon pericostal sutures and two layers of chromicized catgut muscle sutures, completely covering in the gauze and making the chest airtight. The skin edges were approximated—but not united—with three silkworm-gut stitches.

Post-operative Course First Step.—Forty-eight hours later the gauze packings were removed and about thirty ounces of bloody serum escaped. The wound was then firmly closed with broad adhesive strips. The pulse was still rapid (150),

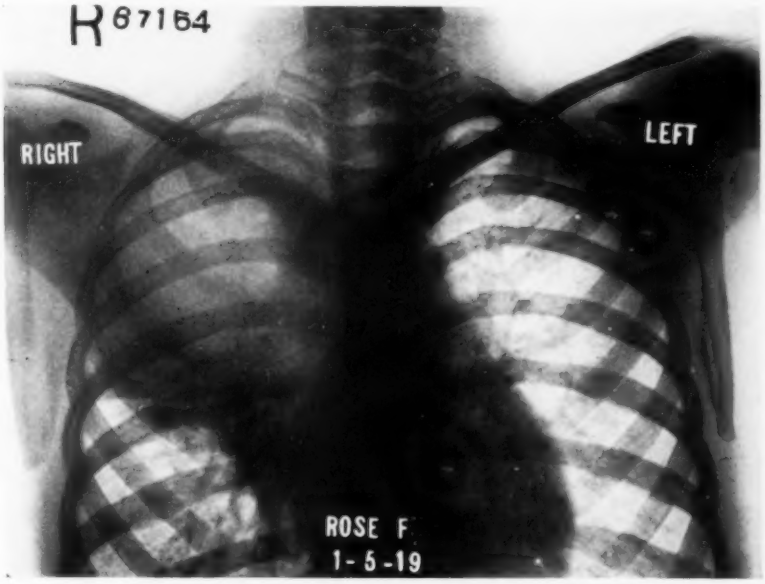

FIG. 9.—See legend on Fig. 7.

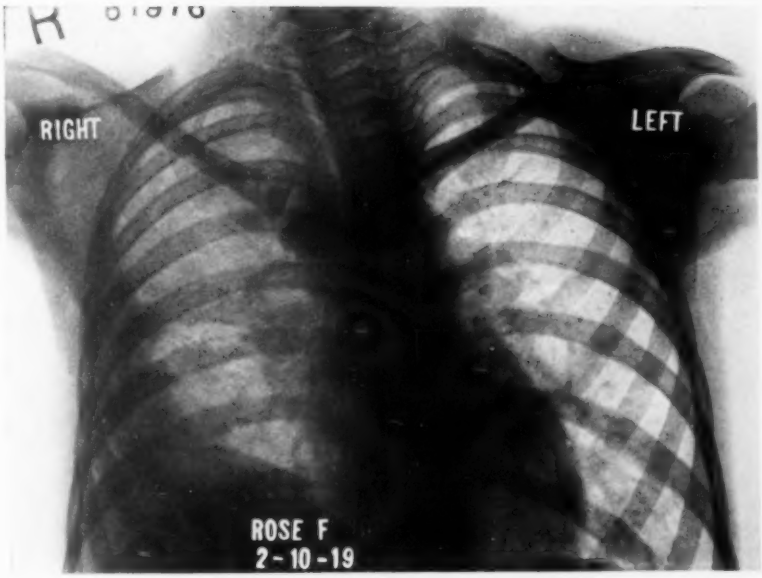

FIG. 10.—See legend on Fig. 7.

but the conditions generally looked not unfavorable. On February 28th, one week after the first operation, the lobectomy was performed. There had been digitalis therapy and the pulse was between 140 and 150, but of fair quality. The temperature had ranged between 101° and 104°. One hour before the operation eight mm. of Magendie's solution were given hypodermatically. Doctor Branower again anæsthetized with a little ether, followed by nitrous oxide and oxygen,

and the intrapharyngeal method was used. Doctor Aschner assisted at the wound.

Operation.—An incision almost to the top of the shoulder was made from the posterior angle of the old wound. The next three upper ribs were divided posteriorly and most of the seventh rib was removed with its periosteum. There was a little annoying bleeding from one intercostal vessel which could only be properly secured after the rib-spreader had been put in. It was now seen that the upper and middle lobes were nicely adherent to the chest wall and were of good normal color. The space in which the rubber dam had been placed was filled with opalescent serum and the adjacent lung surface looked almost like the walls of a pyogenic cavity. The lower lobe had become firmly adherent to the diaphragm, some adhesions having to be cut between ligatures. Where the lower lobe was adherent to the chest wall behind, it had to be peeled away, but the resulting hemorrhage was slight. Orientation up to this time had been difficult.

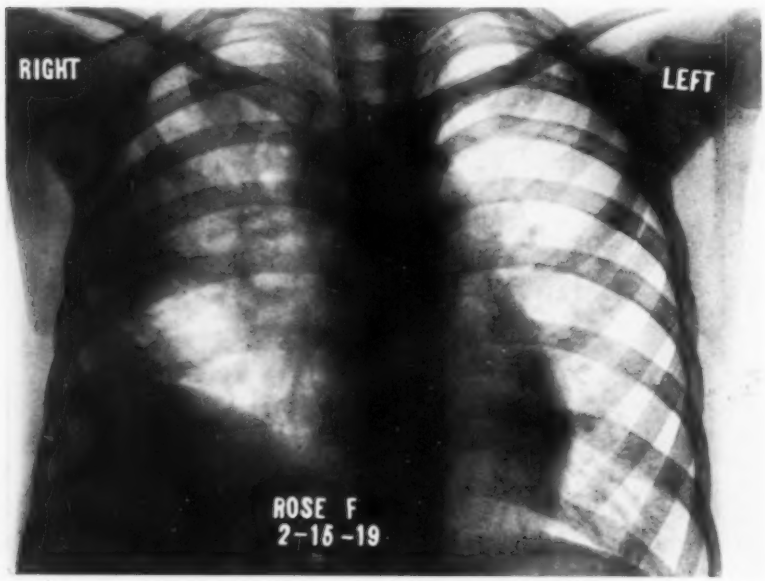

FIG. 11.—See legend on Fig. 7.

A few adhesions between the upper and lower lobes were divided between ligatures. The pedicle was now transfixed by numerous silk ligatures carried on hæmostatic needles, none of which took too large a bite. All ligatures were of No. 3 twisted silk, except one which was not finally counted upon but which encircled the greater part of the pedicle. This silk was of the heavy braided variety, about No. 12. As each ligature was tied the lung beyond it was cut away. At one point a large vessel bled for a second or two, but was quickly secured with a heavy clamp. Ligatures were placed behind this clamp and also distal to it before it was removed. The lobe was at last cut away, the stump carbolized and all ligatures were carried out of the posterior wound, which had been enlarged by the removal of about an inch of the anterior portion of two of the divided ribs. The stump was covered by iodoformized gauze which was led out of the chest in one bunch. An intercostal incision was made low down in the axillary line through which a drainage tube was drawn for drainage at a low level. The muscular parts were sutured, closing the chest, and one pericostal suture of chromicized catgut was also put in, although it could not draw the ribs

together because of the long resection of the seventh rib. The skin was left open, a dry dressing put on and held in place by adhesive plaster, not encircling the chest. The immediate shock was severe on the table; the pulse disappeared, but the transfusion of 1000 c.c. of citrated blood by Doctor Ottenberg, who was present for the occasion, brought back the pulse and reduced the shock.

Post-operative Course.—At the first dressing two days post-operative, the wound was found to be clean. The skin packings were removed, and after iodization the skin edges were drawn together with adhesive plaster. The deep packings were not disturbed. The pulse was still almost 150 but of good quality. At the time of the transfusion some citrated blood got into the tissues of the right arm and there was a rather sharp reaction with considerable painful swelling as far as the shoulder, but under pure alcohol dressings this subsided.

FIG. 12.—Case 10. Miss M. V. Taken three weeks before operation. Shows right lower lobe post-tonsillectomy bronchiectasis.

All the ligatures except the large transfixion suture came away between the eighth and tenth day following operation, leaving the bronchi open. There was the usual foul gangrenous exudate in a large part of the wound and also in the pleura. Oxygen in a continuous fine stream directly from the tank was passed through the chest for twenty-four hours in order to combat anaërobic infection and then the whole cavity was lightly packed with iodoformized gauze. In a few days all odor had disappeared. The heavy silk ligature became very annoying, for it refused to come away, and eventually I had to cut it off in the depths of the wound, illuminating the parts with a flashlight. About April 5th I attempted to use Dakin's solution very cautiously, trying to avoid the bronchial openings. For about three days it was possible to do this. Then, however, there was a severe attack of coughing during the injection, and, although no more Dakin's solution was used, the cough and even a little expectoration were annoying for a few days.

Two months after the operation the patient was up and about, going out for drives and nearly well, although a minute opening still persisted. She showed

the usual great sensitiveness to exertion, even slight exercise being followed by a temperature as high as 101°, when without exercise the temperature remained normal. She left the hospital on May 1, 1920, and has remained perfectly well, exercising, and, in fact, doing fancy dancing.

CASE XI.—*Suppurative Pneumonitis Following Tonsillectomy—Pneumectomy—Death.* Gertrude K., Hospital No. 201,642, eight years old, entered Mount Sinai Hospital on May 27, 1920, with a temperature of 103.8°, pulse of 142 and respirations thirty-eight. Eight months before she had had measles and three weeks before her tonsils were removed in ether anæsthesia because of frequent attacks of sore throat.

Physical examination showed a very ill, poorly nourished, rapidly breathing child, the tongue coated, the left chest expansion limited, fremitus and resonance

FIG. 13.—Case 10. Two weeks later. Great extension.

diminished over left chest, and a few râles, which were cleared by coughing. The pulse was regular but rapid. Urine negative.

The X-ray picture showed an infiltration of the left lower lobe from the seventh interspace to the base, indicating apparently a pneumonic process. No cavities were shown. The child was kept under observation with occasional days of improvement until on June 5th she complained of pain over the region of the apex of the heart, and another X-ray picture now taken showed a dense shadow as of fluid but without displacement of the heart. It was thought that this fluid might be somewhere encapsulated, and it was for this reason that the heart was not displaced. Believing that a lung abscess had perforated, causing some form of empyema, a major intercostal thoracotomy in ether anæsthesia was done on June 7, 1920, the seventh interspace being the location selected. Just previous to entering the chest, and after the skin and muscles had been incised, aspiration was done with a fine needle and hypodermic syringe and pus was withdrawn. After opening the chest, however, no pus was found, but a bluish-red infiltrated left lower lobe. The needle had entered the lung, and even from this tiny

puncture pus exuded, illustrating how easy it is to cause empyema even by the most careful aspiration. An opening was made in the lower part of the chest for drainage and a tube inserted, using the hand within thorax as a guide. A gauze sponge dipped in iodine was roughly wiped over the upper lobe and upper parietal pleura so as to make adhesions here previous to the second-stage lobectomy.

Post-operative Course.—No empyema developed, although there was a little purulent discharge from the drainage wound itself. There was some relief judging by the diminished cough and the general comfort of the patient, but her pulse and temperature remained about the same, the pulse running to about 130 and the temperature to 103½°. The thoracotomy wound, the skin of which had been left open, began to granulate. This case was obviously a bad risk, but recovery without radical operation was considered practically impossible. Therefore, on June 17th, Dr. Harry Goldman anæsthetizing and Dr. Harold Neuhof

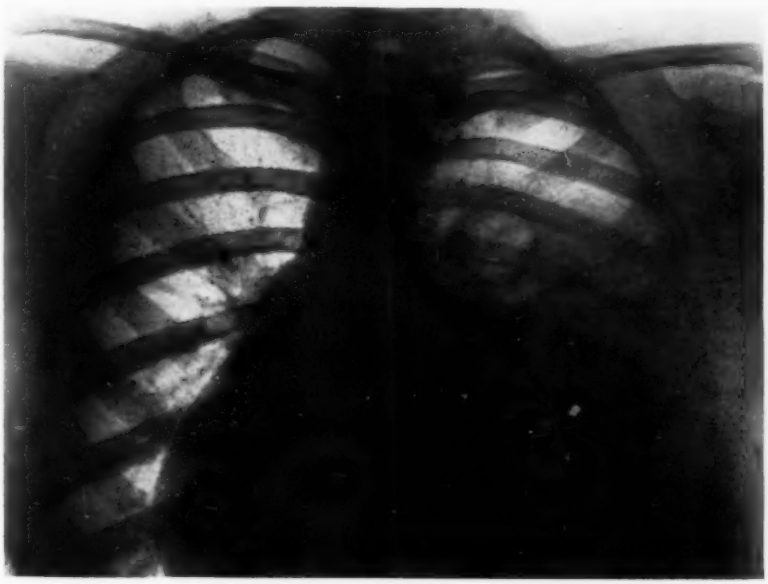

FIG. 14.—Case 10. Day before operation. See history.

assisting at the wound, the entire left lung was extirpated. In separating the lobes pus exuded from the upper as well as the lower lobe. The recent adhesions were quickly broken down and the pedicle ligated with six or seven transfixion sutures of strong twisted silk. Generous stumps were left. Loss of blood slight. Considerable pus appeared at the mouth during the operation and the passages were kept as clear as possible by the use of intermittent suction. The wound was closed with three pericostal sutures and a number of muscle sutures of chromicized catgut. Skin left open. Time of operation twenty-seven minutes. Two hundred c.c. of citrated blood were transfused during the operation by Dr. Ira Cohen. Condition at the end of operation excellent and the patient perfectly conscious before leaving the operating room. The respirations were about forty but without dyspnœa and the pulse of good quality, rate 140. The lack of respiratory embarrassment was explained by the fact that the solidified lung was not functioning before operation. Although the patient reacted well, 90 c.c. of citrated blood were put in the following day.

First dressing forty hours after operation. There was a considerable quantity of serum which escaped when the tube which had been previously clamped was freed.

The expected anaërobic infection appeared but in an unusually malignant form, septic absorption causing diarrhœa with rapid emaciation. A week after operation I was distinctly hopeful, the odor became less offensive and the pulse remained strong. Four days after, however, on account of her diarrhœa and the necessary limitation of food, another sodium citrate transfusion had to be done, this time by Doctor Kaliski, who put in 300 c.c. The hæmoglobin, in spite of the diarrhœa, had dropped to thirty-five per cent. A chill and temperature to 106° followed this procedure, but the reaction subsided, and again there was general improvement. Dr. Herman Schwarz, Associate Pediatrist to the hospital, superintended the diet, but in spite of everything the looseness of the

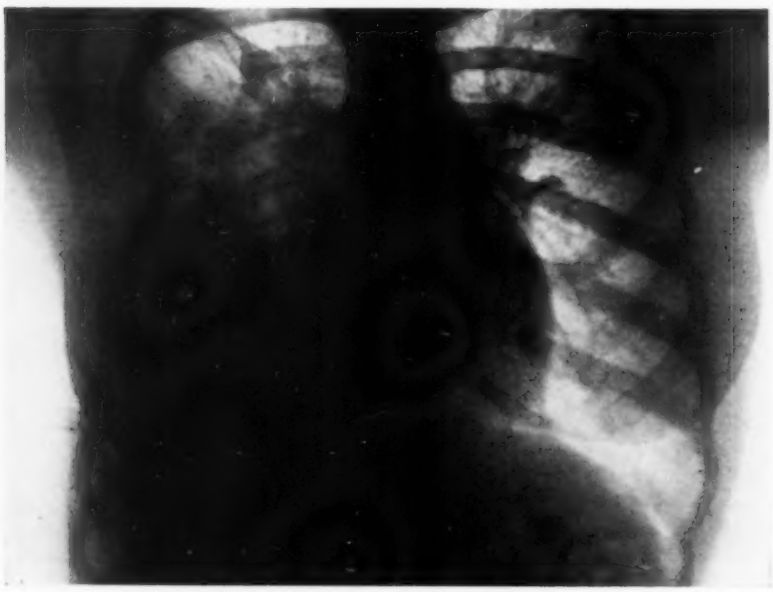

FIG. 15.—Case 10. About four months after operation. Dense shadow means recent scar tissue and thick pleura. Compare with Fig. 16.

bowels continued with as many as thirteen movements a day. The first bronchial fistula appeared about this time. Thirteen days after operation a severe hemorrhage occurred which ceased, however, spontaneously. Careful examination of the chest did not show the source of bleeding. Again Doctor Kaliski transfused with 300 c.c. of blood. About midnight, at the end of the thirteenth day, after another hemorrhage, which had also ceased spontaneously, I examined the wound and found traces of old clotting around the pedicle. While I was examining this a hemorrhage occurred from which she died in a few seconds.

This is the first and only time that I have seen hemorrhage from the pedicle. It undoubtedly occurred from destructive infection of the wall of an important vessel, probably the pulmonary artery, not from slipping of a ligature, for the ligatures were off by this time.

CASE XII.—*Post-tonsillectomy Lung Abscess—Empyema—Thoracotomy and*

Drainage. Abraham G., eight years old, entered Mount Sinai on May 18, 1920, with high fever—103 degrees—and all the signs of acute suppurative lung infection which had followed tonsillectomy three weeks before. Fever, cough, foul sputum and pain in left chest had appeared a week after the operation. Physical signs of left upper lobe pneumonia. Double cardiac murmur at apex. White blood-cells 4000, polymorphonuclears eighty-nine per cent. X-ray examination showed left lung dense from apex to base. May 22nd, bronchoscopy, by Doctor Yankauer, showed acute localized bronchitis, possibly causing obstruction of the left upper lobe bronchus.

May 27, 1920, Doctor Aschner performed a seventh interspace thoracotomy, evacuating foul, thick pus. Some days later I performed major exploratory thoracotomy, encountered a bronchial fistula with such dense lung and with such firm adhesions to the mediastinum that nothing further could be done. However, there was a gradual improvement, and all wounds healed. He had several bad

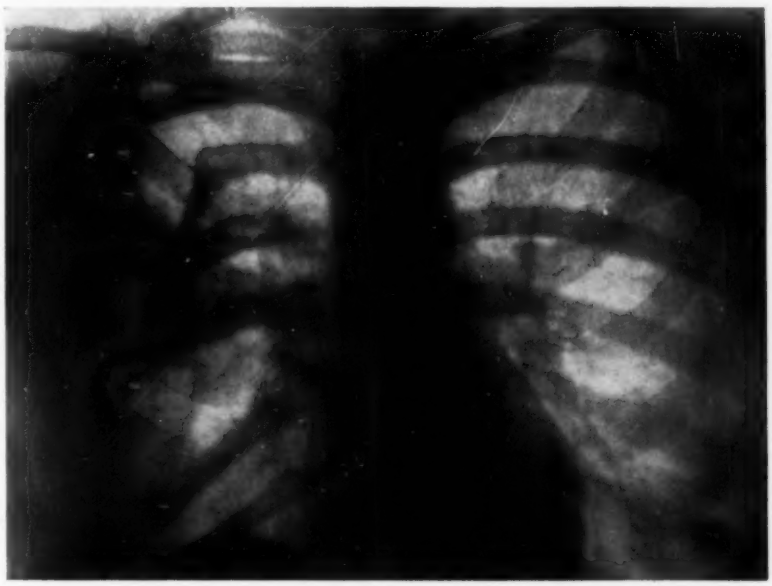

FIG. 16.—Case 10. One and one-half years after operation. Patient remains entirely well. Perfect function. Note bony bridge between three divided ribs. No pneumothorax.

relapses later and at this writing is just recovering with a bronchial fistula from a severe exacerbation.

CASE XIII.—*Bronchiectatic Lung Abscess—Attempted Extirpation—Death.* (Abstract of history reported in the ANNALS OF SURGERY, July, 1916.) Jacob S., 36 years old, Hospital No. 146,288, was admitted to Mount Sinai Hospital on June 2, 1914. Twenty-eight years before he had had pneumonia from which he completely recovered. Two years before he had been operated upon for abscess of the right lung. The present illness began with pain in the right chest, copious expectoration of foul sputum, severe night sweats and vomiting. These symptoms had existed for more than six years and had not been relieved by his operation of two years before when sections of the sixth, seventh and eighth ribs had been removed, evidently with the idea of collapsing the diseased part of the lung.

Pre-operative Condition.—Physical examination showed signs of cavity in the chest, clubbed fingers, cyanosis and rapid pulse. Urine contained a trace of albumin and a few white blood-cells. On admission his temperature was 101.2°, his pulse ninety-six and the respirations twenty-four. The temperature depended largely upon the patient's ability to empty the abscess by coughing. At times he ejected as much as twenty ounces of sputum in a single day.

X-ray examination showed an extensive involvement of the right lower lobe and a portion of the upper lobe.

Bronchoscopy was performed on June 8, 1914, by Doctor Yankauer, and the abscess pretty well emptied, with reduction of temperature and some improvement subjectively. No foreign body was found, but the bronchi were seen to be enormously dilated.

FIG. 17.—Case 10. Wounds healed after right lower lobectomy. Function of arm perfect. Patient perfectly well.

Operation.—On June 11, 1914, in intratracheal anæsthesia with ether an attempt was made to extirpate the diseased part of the lung. A long incision in the sixth interspace was made and the rib-spreader put in. Dense adhesions were encountered everywhere, so it was with great difficulty that I finally succeeded in entering the free pleural cavity, even at this high level. An attempt was made to isolate the diseased part by peeling it away from the parietes. This proved to be impossible, and then an attempt was made to isolate the diseased portion by means of ligation through the apparently healthy lung. During this process, however, although he had not lost much blood and although the lung was well fixed by adhesions which prevented flapping of the diaphragm, the patient suddenly collapsed and the operation had to be stopped. We had taken the precaution to practice blood segregation and the ligatures of the thighs were now cut away. The patient also received twenty ounces of saline solution intravenously with a few drops of adrenalin. He revived, the pulse improved and he was able to respond to questions. About an hour and a half after the operation, however, he died. No autopsy was permitted.

I think it quite possible that oozing from the abscess cavity which had been entered during the operation was instrumental in his final taking off. I was at work over another patient when word came that this patient was bleeding. My house surgeon had at once reopened the wound and packed the abscess cavity from which he stated the bleeding came. This case exemplifies the importance of recognizing an inoperable case after the chest is opened. Had we then satisfied

ourselves with rib resection directly over the abscess, as found on thoracotomy and exploration, with evacuation and packing of the cavity, the operative death might perhaps have been avoided though the patient would not have been cured.

CASE XIV.—*Bronchiectatic Lung Abscess—Resection of Middle Lobe and Part of Two Adjoining Lobes.* This case has been reported in the ANNALS OF SURGERY for July, 1916. The following is a brief abstract:

David J., Hospital No. 150,495, sixteen years old, was admitted to Mount Sinai Hospital on December 2, 1914. His temperature was 99°, the pulse was 90 and respirations 22. Cause of disease unknown. Cough and expectoration had begun six months before and had steadily increased until large quantities of greenish, offensive mucopus were expelled. There was pain in the right chest and a loss of fifteen pounds in weight. The urine was negative. Leucocytosis present; no tubercle bacilli found. The Wassermann blood examination was negative.

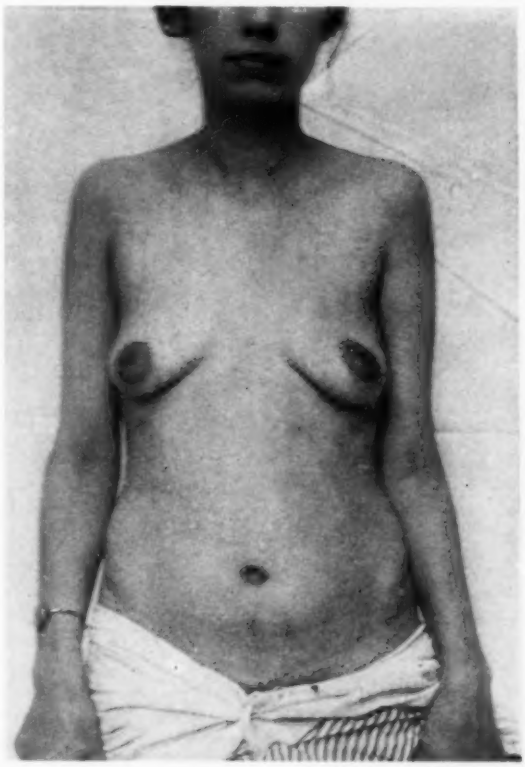

FIG. 18.—Case 18. Fannie B. Patient well after extirpation of left lower and part of upper lobes. Note symmetry of body.

Bronchoscopy by Doctor Yankauer showed a dilated secondary bronchus on the right side from the middle lobe, but a lower branch was also discharging pus.

X-ray Examination.—The X-ray showed a dense shadow the size of an adult palm in longitudinal position roughly in the line of the fissure. The diagnosis before operation was bronchiectatic abscess.

Patient transferred to me by Doctor Manges.

Operation.—On December 28, 1914, in intratracheal anæsthesia by Doctor Branower, a nine-inch incision was made in the sixth interspace. There were general adhesions in the entire chest, so that although anatomically within the pleura, there was no free cavity. The middle lobe—the principal site of the disease—was resected beyond chromicized catgut ligatures and removed. The remaining part of the indurated tissues in the contiguous parts of the upper and lower lobes was surrounded by transfixing ligatures of chromicized catgut through healthy lung. The part of the lung strangulated by these ligatures was not removed but was left to slough off. A piece of the seventh rib was now resected for drainage and the entire cavity packed with gauze which emerged at the drainage opening. The remainder of the wound was closed in two layers without pericostal suture. Loss of blood was slight.

Post-operative Course.—The pulse-rate rose to 140 and two days later the temperature was 103°. Expectoration about two ounces in twenty-four hours

and no longer foul. Cough and expectoration rapidly diminished until on June 22nd they were almost absent. There then developed an encapsulated empyema on the mediastinal side which was opened in local anæsthesia on February 1st. The subsequent progress of the case was satisfactory, although far from steady, with little relapsing attacks of empyema of small size. He was not discharged until May 3, 1915. The wound was then soundly healed, and after a few weeks in the convalescent home he was apparently perfectly well. He remained well until April 29, 1916, when after undue exertion in playing baseball an abscess in the scar developed which communicated with the chest. It was incised under local anæsthesia and quickly healed. I kept track of this boy for two years afterward and he remained well, although subject to colds with slight cough and expectoration. I then lost track of him.

FIG. 19.—Case 18. Illustrating function of arm

CASE XV.—*Chronic Lung Abscess—Extirpation of Right Lower Lobe—Death.* This case has been reported in the ANNALS OF SURGERY for July, 1916. A brief extract follows:

Jacob K., Hospital No. 155.433, patient of Dr. Geo. Mannheimer, fifty-three years old, was admitted on June 16, 1915. The patient had been operated upon for cholecystitis about a year before and had been operated upon again on account of a jaundice in February, 1915. Soon after this he began to cough and the usual symptoms of lung abscess developed with loss of twelve pounds in three months. The patient was pale and emaciated. The lung was emphysematous anteriorly. On the right from the angle of the scapula to the base extending to the axilla râles and flatness. Clubbing of fingers. Urine acid; trace of albumin.

X-ray examination showed a dense shadow which was interpreted as infiltration of the upper part of the right lower lobe.

Operation.—On June 17, 1915, in intrapharyngeal anæsthesia by Doctor Branower, I made a long seventh interspace incision. Posterior part of lower lobe densely infiltrated and dark in color. Infiltration extended also a little way into the middle lobe. The right lower lobe was freed to the hilum and the pedicle being small it was cut off beyond two heavy silk mass suture ligatures. Four bronchi were ligated separately beyond the ligatures after the specimen had been removed. The operation was easy and quick. The stump of the lung was not fixed to the chest wall. The wound was closed in layer sutures and three drainage tubes were left just within the thorax posteriorly.

Post-operative Course.—The patient left the table in good condition with pulse of about 100. In less than an hour, however, his respiration became gasping, his pulse feeble, and he died in a few moments. Probably his death was due to mediastinal flapping.

CASE XVI.—*Suppurative Bronchiectasis (Post-pneumonic)—Lobectomy Right Lower Lobe—Death.* (Abstract from report in ANNALS OF SURGERY, July, 1916.) Joseph S., Hospital No. 160,179, twenty-five years old, was admitted to Mount Sinai Hospital, December 22, 1915. Temperature, pulse and respirations normal. He had had the usual diseases of childhood and six years before admission had had pneumonia and pleurisy for six weeks. The following year he remained well, but then there began cough with profuse greenish expectoration.

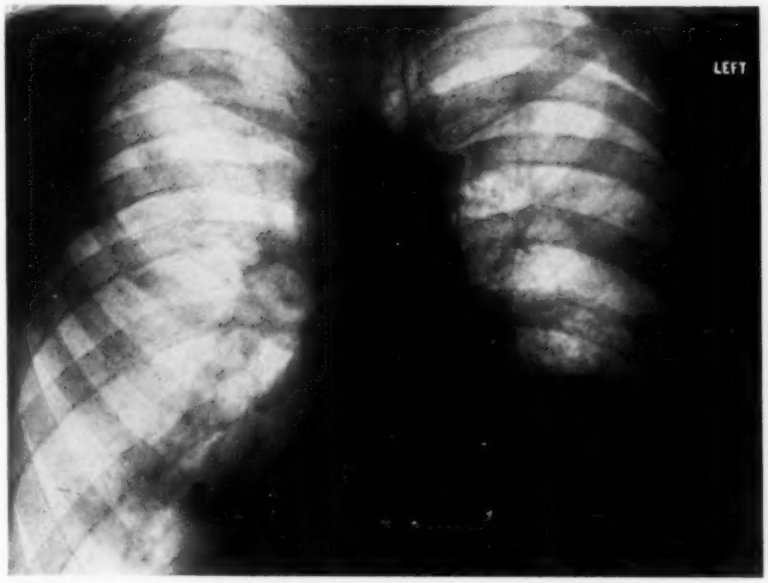

FIG. 20.—Case 21. J. M. W. Preoperative. This is a case of transposition of the viscera. Left lower lobe bronchiectasis. The diagonal right shadow from midchest to base parallel with heart shadow was not considered pathological by the röntgenologists. It suggests to the writer peribronchial congestion.

The symptoms subsided in summer and became aggravated in winter. This went on for about four years, but two years before admission to the hospital the cough and expectoration became continuous, and it was thought that he had tuberculosis until he became the patient of Dr. George Mannheimer, who made the diagnosis of bronchiectasis. There was no fever and no other constitutional sign of sepsis. On admission his condition was good. The right chest posteriorly showed dullness from the spine of the scapula to the base with increased voice and breathing, with sibilant and sonorous râles. On the left side there were similar signs. No tubercle bacilli in the sputum, the total amount of which was about eight ounces in twenty-four hours, foul and purulent in character. The urine was normal. For several years the man had been unable to work and became so miserable and depressed that he begged for relief at any risk. The X-ray showed a shadow occupying the position of the right lower lobe with adhesions between the lung and chest wall and between the lung and diaphragm. The left lower lobe also was not above suspicion.

December 27, 1915, I operated. Narcosis induced by ether was continued with nitrous oxide and oxygen administered by the intrapharyngeal method (Branower).

Operation.—A long eighth interspace incision was made, but it was also necessary to remove the greater part of the eighth rib, to divide the seventh also, just in front of the angle and again near the cartilage, and with the rib-spreader plenty of room was obtained. At the first inspection the case looked inoperable on account of the presence of dense, tough, fibrous adhesions to the chest wall, to the diaphragm and between the lobes. Indeed, in the light of subsequent events this case should probably have been regarded as inoperable. The lobe, however, was finally mobilized, but at the expenditure of much time.

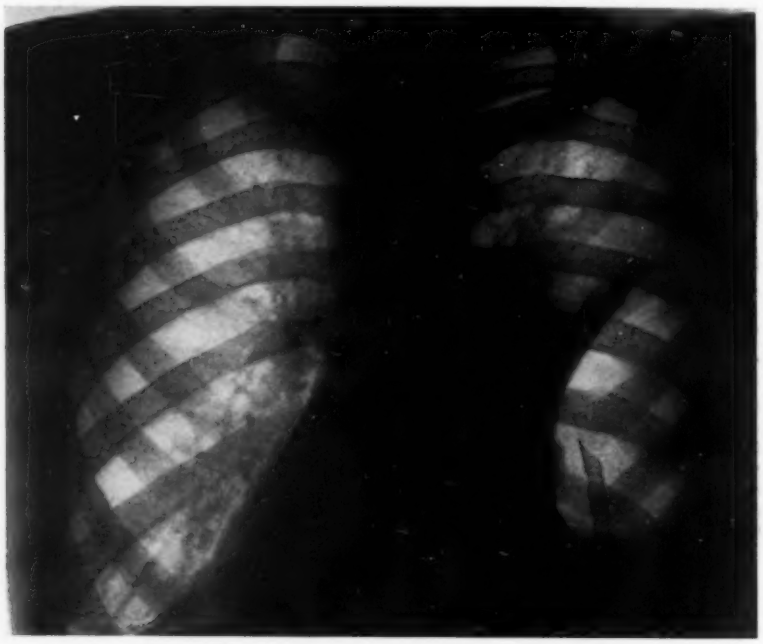

FIG. 21.—Case 21, during healing. Note pneumothorax and drainage tube. The pneumothorax was later replaced by lung tissue. (See Fig. 23.)

It was removed after crushing the pedicle with a special clamp devised by Doctor Yankauer at my suggestion. The pedicle was crushed to a ribbon and was then ligated with fine ligatures of chromicized catgut and the lobe was cut away. Immediate section of the specimen showed great infiltration and numerous greatly dilated bronchi. During the operation possibly eight ounces of blood were lost. The entire right diaphragmatic surface was left raw. All bleeding had apparently ceased at the end of the operation which had lasted nearly one and one-half hours. The ribs were approximated with pericostal chromicized catgut sutures and the mediastinum was steadied with the help of a large suture through the pedicle fastened to the chest wall. At the end of the operation the pulse was 140 but of good quality and the respirations twenty. There was, however, great shock and he was given twenty ounces of saline solution subcutaneously.

Post-operative Course.—Two hours later the pulse rose to 168 and there was cough with slight blood-tinged sputum. It was necessary to give him an intravenous saline infusion three and one-half hours after the operation and the next day he received 300 c.c. of citrated blood. His condition apparently im-

proved and I had great hopes of his recovery, but thirty-six hours after the operation he became unconscious, the right pupil dilated and the left apparently contracted. A lumbar puncture yielded clear fluid under increased pressure. The temperature rose to 107½°, the pulse which had remained good suddenly became weak and he died forty hours post-operative.

CASE XVII.—*Suppurative Bronchiectasis (Chronic)—First-stage Contemplated Lobectomy—Death.* Charles G., Hospital No. 168,304, age thirty-seven, had been operated upon for gastric ulcer in November, 1916, and appeared to make a complete recovery. He entered Mount Sinai Hospital on November 22, 1916, with a history of having cough and expectoration for six months. The discharge was thick, yellowish and foul. It was worse in the morning and frequently

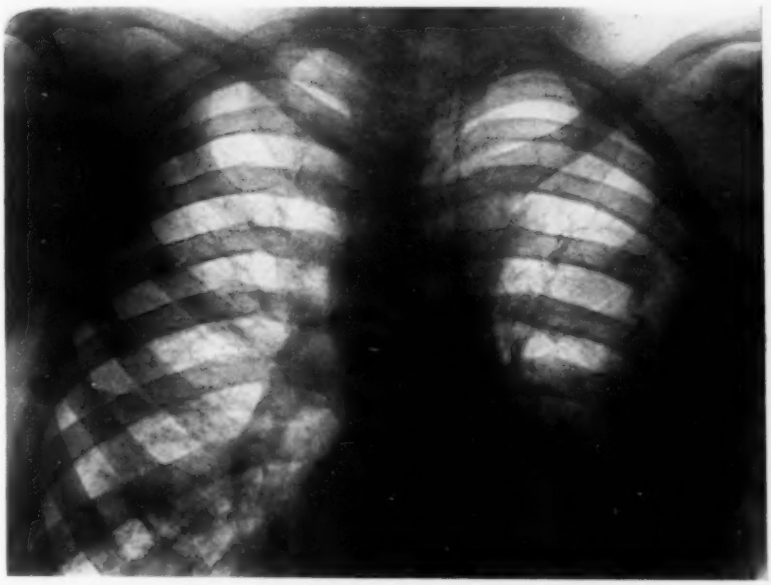

FIG. 22.—Case 21, about 3 months after left lower lobe resection.

accompanied by vomiting. No hæmoptyses. He finally became bedridden and the sputum became blood-stained.

On admission to Mount Sinai the lungs showed crepitating râles all over the right side with dullness toward the base on the right, dullness posteriorly from the angle of the scapula and flatness at the extreme base. There were no elastic fibres and no tubercle bacilli in the sputum. Pulse sixty-four; respirations twenty, and while the temperature was ninety-nine and one-half degrees on admission, there was a history during a sojourn at Bellevue of exacerbation with fever running to 104.

Bronchoscopy.—On November 27, 1916, bronchoscopy by Doctor Yankauer. No pus was seen in the left bronchus but the right was dilated and contained pus from the lower lobe. No pus from the middle lobe. Entrance to upper lobe bronchus swollen and a small quantity of pus seen coming from it.

X-ray.—The X-ray picture showed disease of the right lower and possibly middle lobes toward the hilum, the interpretation being suppurative bronchiectasis.

On December 7, 1916, in general anæsthesia I operated.

Procedure.—I made a long eighth interspace incision and divided the seventh and eighth ribs posteriorly to permit good exposure. Most of the disease was

found near the hilum in the lower and middle lobes; the upper lobe was adherent to the chest wall by a few tender strands. It was rubbed briskly with gauze, the costal pleura was also rubbed with gauze and then painted with tincture of iodine. The chest was then completely closed and the lungs during closure were kept inflated by Doctor Branower with the aid of the intrapharyngeal insufflation.

Post-operative Note.—This patient never came to his second stage because he died apparently of septic pneumonia four days after operation. Unfortunately there was no autopsy.

CASE XVIII.—*Suppurative Bronchiectasis—Left Lower Lobectomy and Partial Resection of Upper Lobe.* Fannie B., Hospital No. 196,598, sixteen years old, was admitted to the Medical Service at Mount Sinai on November 17, 1919, in the care of Doctor Celler. At five and one-half years of age her tonsils had been removed and she had remained well until one year before admission when there began pain in the left chest and expectoration of mucoid, greenish material, increasing in quantity; then there was a gradual recession until on admission the daily expectoration amounted to about two ounces of slightly fetid sputum. Her temperature was 102.2°, the pulse was 124 and the respirations were 24. Her general condition was excellent and there was no clubbing of the fingers. There was dulness from the scapula to the base of the left lung with diminished breathing and crackling râles.

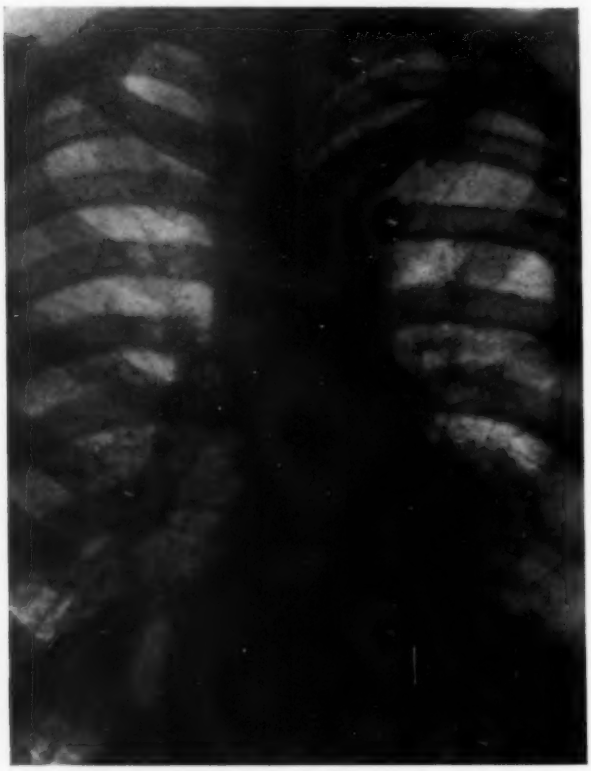

FIG. 23.—Case 21. One year after lobe resection. Patient still has some expectoration and still has nasal sinusitis. Otherwise well.

Pathological examination of the blood showed 11,000 white blood-cells, seventy-five per cent. polymorphonuclears and twenty-four per cent. lymphocytes.

The X-ray showed the heart drawn to the left and a shadow occupying the lower part of the chest from the base of the heart exteriorly to the ninth rib exteriorly.

Bronchoscopy by Doctor Yankauer demonstrated pus from the left lower bronchus.

I operated on December 4, 1919, in intrapharyngeal ether administered by

Dr. J. Lawrence Jones of the House Staff, assisted by Doctor Aschner. Doctor Neuhof acted as first assistant at the wound.

Operation.—A long eighth interspace incision was made and the rib-spreader inserted. The entire lower lobe was dark in color and greatly contracted. A few adhesions held it firmly to the diaphragm and to the upper lobe. The lower anterior edge of the upper lobe was also dark and sharply defined from the normal lung. The diseased lung was soft, contained air, and a number of nodules were felt. After enlarging the wound posteriorly, the eighth, seventh, sixth and fifth ribs were divided and part of the eighth rib was resected. Extirpation of the lower lobe was now performed after division of the adhesions, and a resection of the diseased part of the upper lobe about two and one-half inches long and one inch wide was made. The stump of the lower lobe was carbolized. An incision was made in the lower part of the chest for drainage, and after drawing the ribs

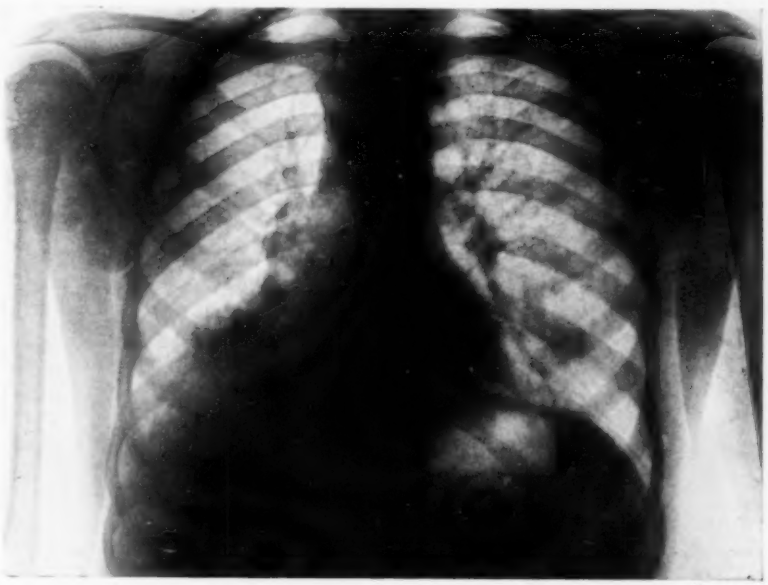

FIG. 24.—Case 29. Gussie P. Congenital bronchiectasis, right lower lobe, later infected. Before operation.

together the wound was sutured by pericostal chromicized catgut sutures. The ligatures from the stump were drawn out of the posterior wound and fastened there at slight tension to steady the mediastinum. All ligatures and also the end of a piece of gauze which had been carried to the stump were buried beneath the skin suture so as to make the chest airtight. The distal end of the tube from the drainage wound was now submerged beneath water and the lung was distended until all bubbles ceased to appear; then the tube was clamped. The wound was dressed and after the patient was put to bed the end of the drainage tube was carried under weak lysol solution and the clamp removed according to Kenyon's method for drainage.

Post-operative Course.—The operation was well borne, the pulse was steady throughout, no blood appeared at the mouth and the patient's color was good. The reaction temperature never exceeded 101 degrees. Thirty-six hours post-operative the first dressing was done; there was comparatively little discharge. The sutures over the buried gauze and ligatures were removed. The patient, however, was coughing as much as six ounces of thick, tenacious mucus. This diminished under guaiacol carbonate medication.

On the eighth day after operation the ligatures came away spontaneously. The same day suddenly the respirations rose to forty and became shallow. The patient's color became ashen (not cyanotic) and the appearance anxious. I was out of town for the day and Doctor Wessler discovered a pneumothorax pushing the heart and mediastinum far to the right. The pulse remained good, however, not rising higher than 120. The following morning I aspirated about 600 c.c. of air through an anterior puncture in the third interspace. The X-ray showed fluid, but the level could not be determined since the patient was not examined in the erect position. (In this case it is my theory that the pneumothorax was due to the rapid absorption of the ligatures around the stump of the resected upper lobe which was on the mesial side and that the patient's violent coughing had resulted in air leakage from this stump through the smaller air passages. Either unchromicized gut was given me, although it was stained the red color of the Mount Sinai chromicized catgut, or the gut had been insufficiently chromicized, for this gut ordinarily remains unabsorbed six weeks.)

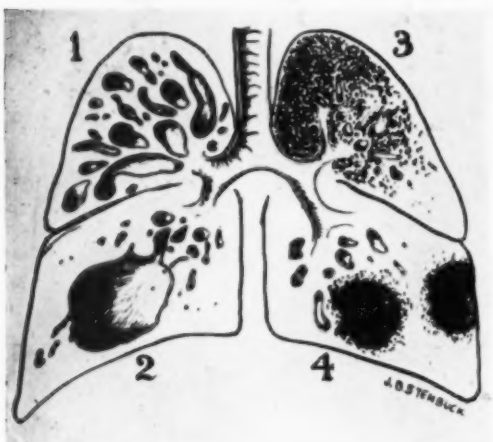

FIG. 25.—Diagram showing four types of pulmonary suppuration. 1. Bronchiectasis. 2. Bronchiectatic abscess. 3. Suppurative pneumonitis. 4. Extrabronchial abscess.

On December 14th, after fluoroscopy by Doctor Wessler and myself, in which a fluid level was clearly demonstrated crossing the median line, the patient was taken to the operating room and without anæsthesia a block-tin catheter bent to the curve of the chest was passed through the anterior adhesions into the pneumothorax. The dilated opening evacuated air and about a pint of perfectly clear yellow fluid. After this, except for occasional setbacks due to retention, there was continued improvement. The upper wound closed, but a long tube was kept in the lower opening because of sacculation in the chest. She was discharged a few weeks later, apparently well.

About April 24, 1920, the patient was readmitted to Mount Sinai with fever, cough and muco-purulent expectoration. In the upper wound behind the scapula was found a small area of softening where it was believed an empyema might break through. The X-ray showed a small fluid level in the region of the upper wound. A day or two later a sliver of rib was extruded from this point. There was no connection with the thoracic cavity.

On April 28th, with the patient sitting up in bed, I put an aspirating needle through the cicatrix behind the scapula into the chest with the idea of finding the pus. Instantly there was a sharp hæmoptysis and on withdrawing the needle a stream of blood, two or three drams in all, ran down the patient's back. She strangled, became cyanotic, gasped for breath, the pulse became extremely rapid, there was perspiration and for a moment it looked as if a fatal accident had occurred. About three or four ounces of blood were expectorated. The bleeding stopped at once after the inhalation of amyl nitrite and ligation of the thighs. Next day, with the exception of the expectoration of brownish muco-purulent sputum, the patient had returned to the normal state. Two days after

the hæmoptysis the X-ray showed the left chest almost filled by lung, only a pneumothorax at the apex remaining. The temperature had dropped and while there was still slight streaking of the sputum the patient was in excellent condition. Finally, all symptoms disappeared and the patient was discharged apparently well after a residence in the hospital of about three weeks. She probably had a pneumonia which may not have been connected with her old trouble. The last report in October, 1920, was that "she is well and has gained many pounds." (Figs. 18 and 19.)

Bronchiectasis: Left lower lobe one stage lobectomy.

CASE XIX.—Mrs. A. M., twenty-six years old, was referred to me by Doctor Bertram Waters. First signs of the disease appeared four years before I saw her. No actual assignable cause for her condition excepting a history of

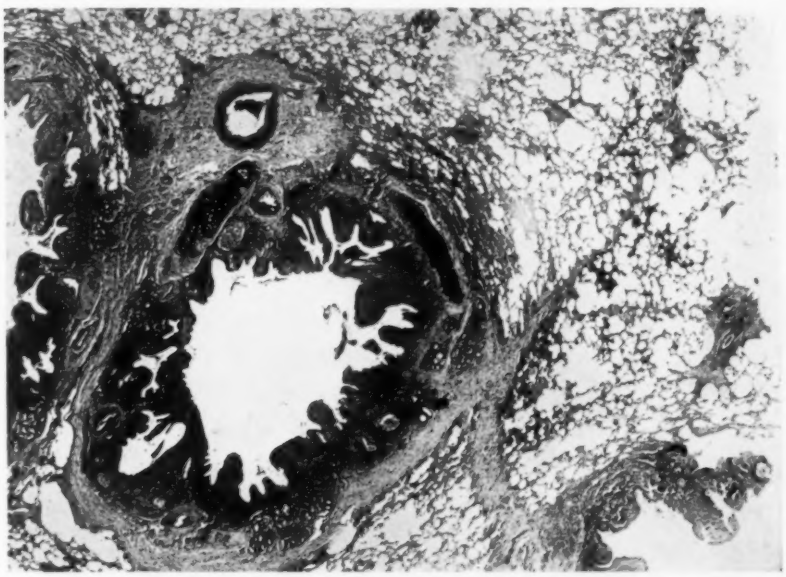

FIG. 26.—Bronchiectasis, cross section of bronchus, showing thick infiltrated papillary mucous lining.

frequent colds with bronchitis. Influenza in December, 1918, from which she never entirely recovered. Tuberculosis was suspected but tubercle bacilli were never found.

Pre-operative Course.—Left lower lobe showed definite signs of cavitation, diagnosed as bronchiectatic. Daily evacuation of large quantities of foul, purulent sputum occasionally blood streaked. The disease progressing gradually, artificial compression pneumothorax was made at the Loomis Sanatorium. This resulted in collapse of the upper normal part of the lung with little effect on the diseased portion. There was, however, some improvement in the general condition with slight gain in weight and with less sputum.

Bronchoscopy by Doctor Yankauer demonstrated the disease confined to the left lower lobe.

Life was intolerable to the patient and she asked for operative relief.

Operation, December 16, 1920, Private Pavilion, Mount Sinai Hospital. Anæsthetic administered by Doctor Branower. First assistant, Doctor Neuhof. Procedure: Long seventh interspace incision with removal of seven inches of the eighth rib with its periosteum. Incision then carried up behind the border of

the scapula dividing the seventh and sixth ribs. Lower lobe was contracted and solid. Upper lobe showed a few small patches of discoloration, suggesting possible areas of bronchiectasis. Adhesions few and easily divided. Lobectomy at once performed because it was believed that the conditions were safer now than they ever would be again. Operation easy and bleeding slight. No transfusion. Counter-opening in lower part of the back with resection of a short piece of the tenth rib and through this opening airtight tube drainage was secured. The principal wound was then closed with pericostal and muscle sutures, skin being left open and packed with a strip of gauze. Condition at the end of operation excellent.

Post-operative Course.—A sharp reaction with temperature to 104° and pulse 130 twelve hours after operation. In twenty-four hours after operation, abdominal

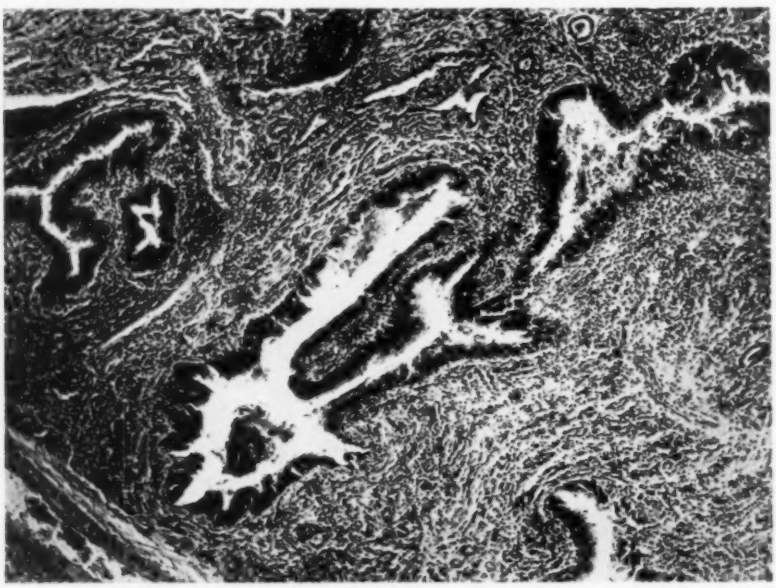

FIG. 27.—Bronchiectasis, longitudinal section of bronchial branches, showing peribronchial infiltration and fibrosis.

distention with cyanosis and dyspnœa and the continuous belching of enormous quantities of gas accompanied by brownish-black, foul-smelling fluid from the stomach. Abdominal distention at first relieved by rectal irrigation, but the patient quickly failed and died fifty-nine hours after operation. No post-mortem examination.

A few days after the death of this patient Doctor Neuhof happened to meet a physician who resided in the tropics and who stated in regard to a fatal abdominal case of Doctor Neuhof's in which curious whitish bodies were present on the viscera that he believed that the disease from which Doctor Neuhof's patient died was sprue, which is endemic as a visceral disease in the West Indies, where my patient resided. A fatal outcome of the condition, peritonitic in character, frequently occurs after any capital operation, no matter what its character may have been, and so well known is this condition that in the presence of sprue one does not operate except in emergencies. Doctor Neuhof suggested that this might have been the case with my patient, and I then recalled that she had had an indolent ulcer of the posterior right part of the tongue. This was called to my attention by the nurse

during the post-operative period. I did not think that the condition at that time would influence the result. Unfortunately no culture was made. As soon as I knew of the possible complication of sprue I requested Doctor Aschner who had the lung specimen to try to isolate the monilia. This, however, was impossible, as the specimen had already been put into antiseptic preserving solution. It is interesting to know that the above facts in regard to this disease are being studied by Colonel Ashford for the United States Army at San Juan, Porto Rico, and that a number of articles on this subject have been written.

Case XX.—*Bronchiectatic Lung Abscess—Exploratory Thoracotomy.* Morris U., forty-two years old, was admitted to Mount Sinai Hospital April 10, 1920. Epilepsy for past five years. Eleven months before admission hæmoptysis of about a drachm. A month later began characteristic signs and symptoms of

Fig. 28.—Bronchiectasis, mucosa more highly magnified.

pulmonary suppuration on the right side. Since February, 1920, cough, fever, loss of weight.

Physical examination showed signs of infiltration of right lower lobe and this was confirmed by X-ray examination. White blood-cells 8200; polymorphonuclears, forty-two. I refused to operate, but patient threatened suicide because he could not even find a place in a sanitarium on account of the fetor of his expectoration. Wassermann examination negative.

On April 12, 1920, I operated, making wide exploration of the right chest. Most of the upper lobe free but remainder of lung solid and adherent. Adhesions were broken down and chest closed to await second stage. April 19th, patient was doing badly, with signs in opposite chest. Still, in nitrous oxide and oxygen by Doctor Branower, I reopened the wound and opened and packed the abscess, not attempting lobectomy. No pleural infection was found at second stage, but he died half an hour later.

A wound examination showed the opposite lung diseased much as was the right side, though this had not been diagnosed by X-ray. Doctor Yankauer and I feared preoperative bronchoscopy because of epilepsy.

CASE XXI.—*Suppurative Bronchiectasis; Lobectomy, Left Lower Lobe.* J. M. W., twenty-three years old, was referred to me by Dr. James A. Miller on September 22, 1920. From the age of three this patient had suffered from nasal sinusitis, and there was an operation on the frontal sinus at that early age. Since then there were numerous other operations and the sinuses are still infected. The patient had influenza pneumonia twice. Cough had been present for six and a half years with purulent expectoration, usually foul but without blood. The amount varied from 250 to 400 c.c. per day. No tubercle bacilli were found. There were numerous exacerbations with fever. Clubbing of the fingers was present.

The X-ray pictures showed opacity of the left lower lobe but the right lung did not appear to be perfectly clear. The viscera of the patient were completely transposed.

Doctor Miller had treated the case with nitrogen pneumothorax and the X-ray then showed adhesions of the region of what might be the middle lobe

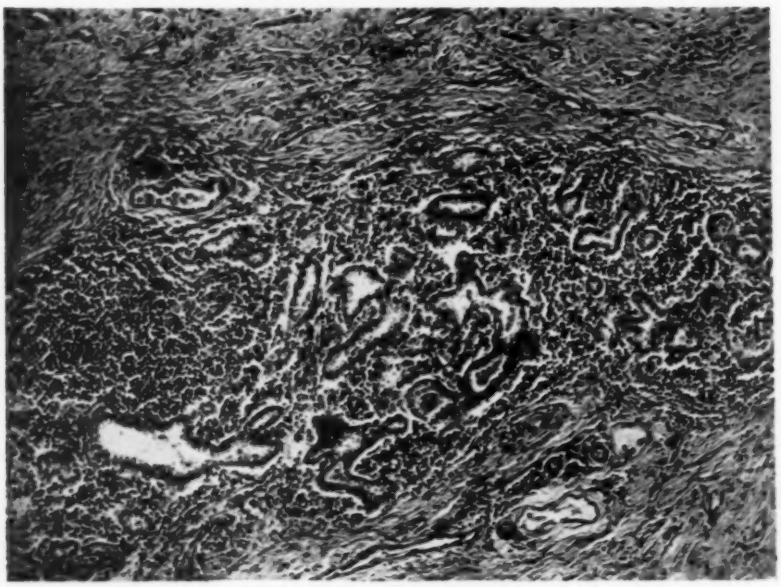

FIG. 29.—Proliferation of air passages in an area of fibrosis.

to the chest wall and of the lower lobe to the diaphragm and chest wall and so the collapse of the lower lobe was only partial. Bronchoscopy by Dr. Chevalier Jackson had been done in the hope of finding a possible foreign body, but none was found. On my advice another bronchoscopy was performed by Doctor Yankauer, who reported that the principal seat of disease with dilatation of the bronchi was in the left lower lobe, though the upper lobe did not appear to be perfectly clear. The right lung, however, was not diseased. No middle lobe bronchus was found. In the presence of the nasal infection, which was probably the prime cause of the entire pulmonary trouble, I hesitated to advise operation and suggested pulmonary lavage, but the patient refused this, preferring an operative attempt at cure. Operation was performed on October 27, 1920, at Mount Sinai Hospital. Anæsthesia in ether, then gas and oxygen by the intrapharyngeal method, with occasional suction (Doctor Branower).

Operation.—First stage. A long seventh interspace incision was made with resection of about eight inches of the eighth rib, including the periosteum. About

seven ounces of sanguinolent fluid was found in the chest. To our surprise the greater part of the lung was normal in appearance and density, the diseased area being rather dark and sharply defined, occupying the lower half of the left lower lobe, where on handling coarse crackling was made out and pus appeared at the patient's mouth. The two adhesions shown by the X-ray were broken down without the slightest difficulty and at these two points there was what appeared to be recent lymph coagulum. As preparation for a possible second-stage resection, gauze was placed between the upper lobe and the chest wall so as to cause adhesions and another piece of gauze was then placed between the lower lobe and the diaphragm. The chest was then closed without drainage by suturing the muscles, the skin left open and packed with iodoformized gauze. The patient stood the operation well.

Two days later, in nitrous oxide anæsthesia in bed, a few of the muscle sutures were removed from each angle so that the gauze could be withdrawn.

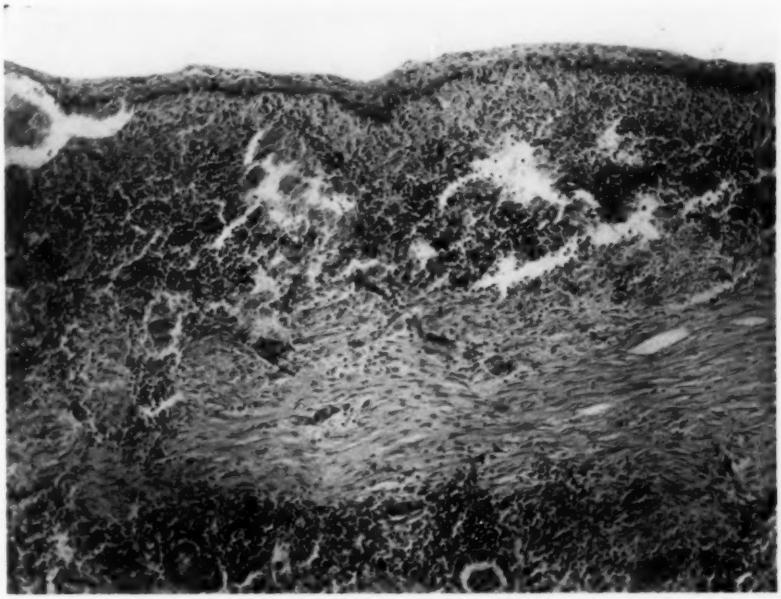

FIG. 30.—Bronchiectatic abscess wall, section near entering bronchus showing epithelial lining of cavity and muscular coat still present.

About a pint of non-odorous, sanguinolent fluid escaped. The wound was then strapped to prevent sucking.

Operation.—Second stage. On November 3, 1920, the patient having been prepared for forty-eight hours with digitan the lung resection was done. The anæsthesia was administered by Doctor Branower. First assistant at the wound, Dr. Harold Neuhof. Wound reopened by cutting sutures and rib-spreader inserted. No fluid found. The diseased part of the lower lobe was adherent to the diaphragm, upper and middle (?) lobes adherent to the chest wall. During the operation it was necessary to loosen some of the adhesions of the upper lobe to the chest wall, but a number remained firm posteriorly. The middle lobe was not fully developed, although a sulcus of demarcation was present. The infected part of the lower lobe was cut away beyond numerous ligatures of chromicized catgut and silk passed through the healthy pulmonary tissue. This made an unusually broad base or pedicle. The seventh rib was cut through posteriorly

and a short section, about an inch and a half, was removed for drainage. Another drainage opening was made into the back, through which a large-calibre tube was passed between the ribs into the chest low down. The stump area was carbolized and the ligatures tied together with a fillet of silk. This mass of ligatures was passed through a hole in a large piece of rubber dam which embraced the neck of the pedicle, broad though it was, and then this sack of rubber dam was filled with gauze, the entire mass of rubber dam, gauze and ligatures being led out through the upper posterior part of the wound. The mediastinum was steadied by traction made by fastening the bunch of ligatures to the chest wall. Three pericostal sutures approximated the ribs to within about three-quarters of an inch of each other and the remainder of the thorax was closed with chromicized catgut sutures through the muscles in two layers; skin wound left open. After the operation the patient was considerably shocked, although the blood-pressure which before the operation

FIG. 31.—Bronchiectatic abscess wall, a more peripheral area, showing epithelial layer covering vascular granulation tissue.

had been 115-100 had been reduced to but 100 systolic. Doctor Ottenberg then transfused by the citrate method 700 c.c. of blood.

Post-operative Course.—The convalescence was far from simple. A section of the stump came away fifteen days after operation and two days later the other section, but a transfixion ligature which had been put in for security was very slow to be dislodged, finally coming away twenty-eight days after the lobectomy. For a time the sputum almost disappeared and the cough improved greatly. By December 6th, however, some sputum had reappeared (about 90 c.c. per twenty-four hours) and this has continued up to the present time. About four weeks after the lobectomy when everything seemed favorable a pneumonia developed in the right lung which caused me great concern. It cleared up, however, without leaving any trace. A small bronchial fistula persisted at the time of his discharge from the hospital on January 17, 1921, but it finally closed completely. A note on April 4, 1921, stated that the "wound is healed; patient in fine general condition, but there are still about two and one-half ounces of expectoration." A tube

through the lower drainage opening was not removed until a mere narrow track was all that was left of the cavity.

This patient cannot be considered cured because he still has some cough and expectoration. He has submitted to other nasal operations since the lobectomy but the sinuses are still infected. Judging by the most recent X-ray pictures it appears possible that there is a small patch suppurative in character near the site of the resection. Whether this is an extension or not it is impossible to know. At the time of the operation all visible and palpable pathological lung tissue was extirpated.

CASE XXII.—*Suppurative Bronchiectasis—Lobectomy Left Lower Lobe—One Stage.* Miss Josephine E., eighteen years old, entered Mount Sinai Hospital June 17, 1921. For nine years she had cough with purulent sputum. Her tonsils

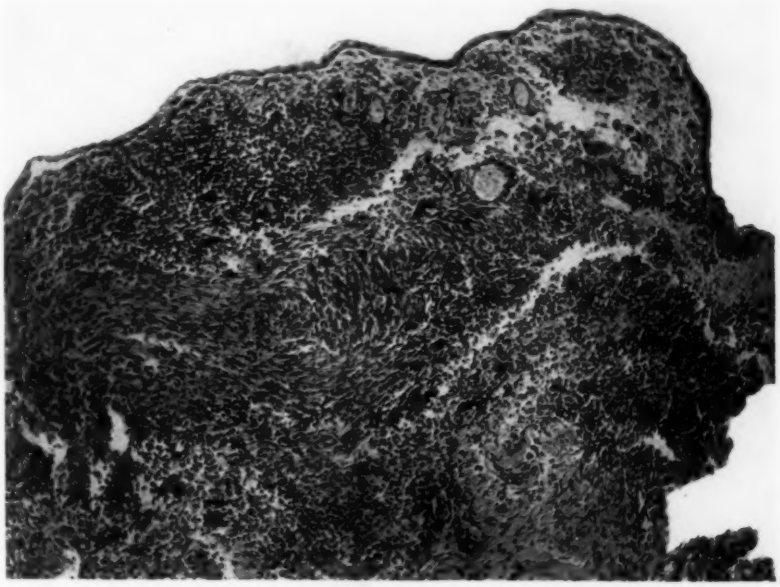

FIG. 32.—Bronchiectatic abscess wall, a remote area showing thin squamous epithelial lining.

had been removed a year before her admission, this of course having no relation to her disease. The amount of sputum was great and the odor indescribably foul. There were periods of emptying with comparatively little sputum in the intervals. For a year she had been treated bronchoscopically nearly every week by Doctor Yankauer, who kept her condition tolerable by lavage of the dilated bronchi, which were clearly observed through the instrument. During the three months preceding her admission, however, there had been a loss of twenty-two pounds in weight. There was no fever and no tubercle bacilli had been found on repeated examination. The breath had a gangrenous odor. There was slight dulness and few râles at left base posteriorly. There was clubbing of the fingers. The general nutrition was fair in spite of the great loss in weight. Urine examination negative. Blood Wassermann negative.

The X-ray showed opacity occupying the lower part of the left lower lobe. The right chest was apparently free. Doctor Yankauer stated that the disease was limited to the left lower lobe.

Her parents had been opposed to operation, but when she became eighteen years

of age she took matters into her own hands and insisted upon a chance with surgery, although well aware of the great dangers.

On June 20, 1921, I performed a left lower lobectomy, Dr. Harry Goldman beginning the administration of the anæsthetic, which was continued by Dr. L. Mason Lyons, House Surgeon. Sodium citrate given intramuscularly. Doctor Neuhof and Dr. Ira Cohen assisted. Although the patient had apparently emptied her pus focus before operation, a considerable quantity escaped during narcosis.

Procedure.—A long seventh interspace incision extending upward behind the scapula with section of the eighth, seventh and sixth ribs. The upper lobe was adherent to the pericardium in its lower anterior part, the upper portion of the lobe being free. This lobe showed a small atelectatic area not larger than a silver quarter and not infiltrated. The lower lobe was adherent to the diaphragm by a few

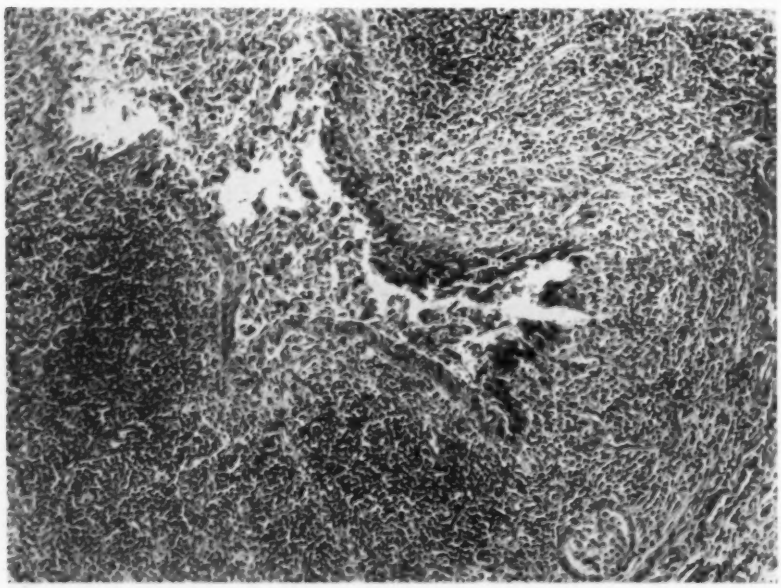

FIG. 33.—Bronchial branch with beginning epithelial metaplasia.

tough but fine adhesions which were easily divided. The lobe was not discolored, but it felt more fleshy than normal and there were dense nodules within the lung tissue with numerous large nodes in the hilum. Although there were no adhesions of the upper lobe and the case therefore should have gone into the two-stage group, the conditions were so tempting for an immediate lobectomy that I carried out this plan according to my present technic. Twenty-four hours after operation there had been free drainage of bloody serum and the patient received 300 c.c. of citrated blood. Three days post-operative the upper part of the wound was opened and the gauze changed. Soon afterward there were signs of tense pneumothorax with the heart pushed to the right. The cause of this proved to be the accidental slipping out of the tube, although it had been fastened to the fascia with a catgut stitch. A separate chamber had established itself in the wound on the mediastinal side and it was in this chamber that the pneumothorax had occurred. The tube was at once replaced and suction established. The patient was immediately relieved and in a few hours the heart was in its normal position. Nine days after operation there occurred a pneumonia on the opposite side with rapid respirations and much prostration. On July 5th there was a large bronchial fistula,

but the stump had not yet come away. Respirations had been so rapid for the past two days that I closed the entire thoracic wound with adhesive plaster and an occlusive wet dressing which gave the patient much relief. Three weeks after the operation the main slough came away through the upper wound and the patient's condition became good. On July 18th—twenty-eight days after the operation, when she was nearly well with only a small tube in the lower cavity, there was a sudden and dangerous hemorrhage. Fortunately Dr. Ira Cohen happened to be present. The removal of the tube was followed by a gush of blood and some blood was also coughed up, the patient going into a condition of shock. Doctor Cohen at once reopened the small granulating upper wound and packed the chest as well as he could and the patient was taken to the operating room, where I examined her in nitrous oxide and oxygen. I recognized that there

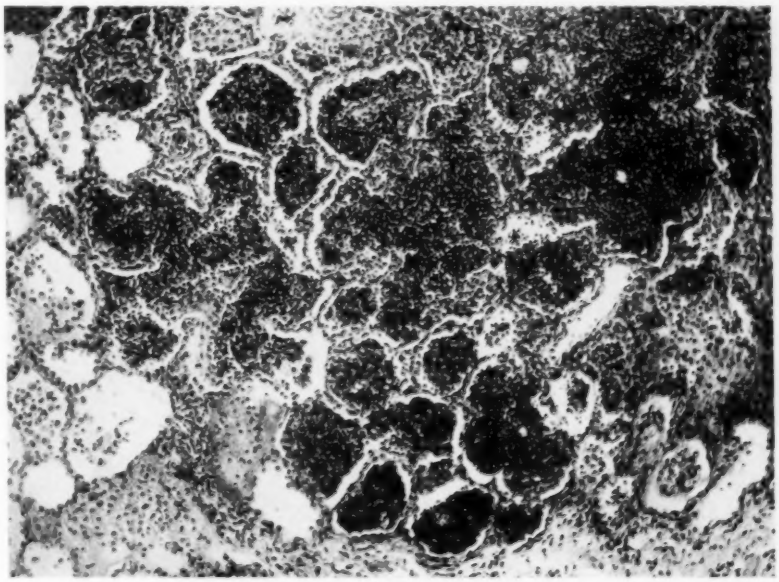

FIG. 34.—Suppurative pneumonitis, purulent exudate in alveoli, septa breaking down.

were two places where the hemorrhage might have originated. The most probable was erosion of an intercostal artery by the drainage tube. The other was from the region of the stump which would have been much more serious. On removing the packings there was an alarming hemorrhage, and because I wished to inspect the most dangerous region first I crashed through the soft parts and new bone with a large rib cutter and opened about four inches of the wound, putting in a rib-spreader. The stump was perfectly clean and there was no sign of bleeding there. The lower wound was then immediately enlarged and a rib resected. A spurting intercostal, evidently the source of bleeding, was caught in a hæmostatic suture. A few hours later Dr. N. Rosenthal gave a transfusion of 240 c.c. of whole blood by the Unger method. From this time on recovery was uninterrupted and she was discharged late in July with the wounds not quite healed. November 14, 1921, the patient having reëntered the hospital because the upper wound was still discharging moderately, I removed a rib sequestrum in light anæsthesia. There were slight hæmoptyses for two days after operation but the patient's general condition is excellent. She is up and about and will leave the hospital tomorrow with a clean granulating wound, this time, it is hoped, "for good." Careful

measuring of the sputum, no longer foul, showed only from one-half to three-quarters ounce in twenty-four hours and the amount is rapidly diminishing. Prognosis for permanent cure excellent.

CASE XXIII.—*Bronchiectatic Lung Abscess—Right Lower Lobe; First-stage Lobectomy.* Max L., sixteen years old, was transferred from the Medical Service of Doctor Libman at Mount Sinai Hospital to my service on May 11, 1921. A nasal operation of some sort had been performed four years previous; three years before there had been pneumonia which the patient believed was right-sided; about two years before, tonsillectomy had been performed and about one and one-half years previous, without immediate apparent cause, there began productive cough with foul expectoration, and he entered the hospital for the relief of this condition. On admission he was in good general condition, although he was

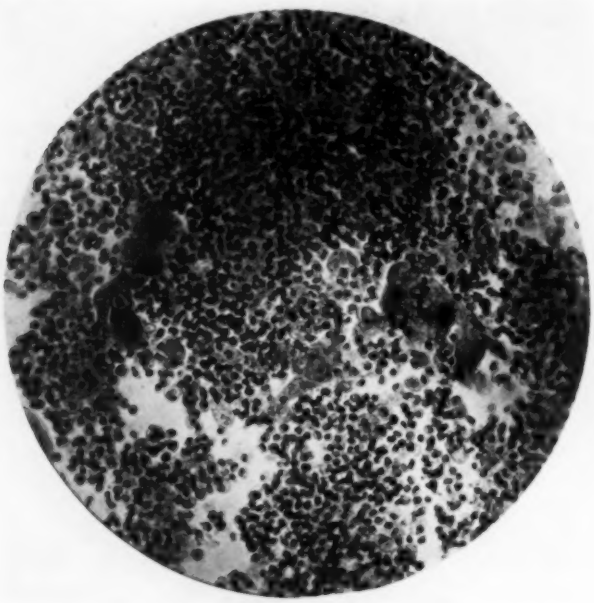

FIG. 35.—Suppurative Pneumonitis, higher magnification.

slightly cyanotic and there was infiltration of the right lower lobe. Examination of the blood showed the hæmoglobin to be 110 per cent., red blood count 5,200,000, and blood-pressure 106 over fifty-six. The sputum was negative for tubercle bacilli. The X-ray showed a shadow in the right lower lobe which suggested suppurative bronchiectasis. Bronchoscopy by Doctor Kempfer revealed pus coming from the bronchi, but the patient was unmanageable and the examination was unsatisfactory. A thoracotomy for exploration was advised and performed on May 12, 1921, in general anæsthesia with nitrous oxide and ether, administered by Doctor Branower. Doctor Neuhof assisted at the wound. Sodium citrate was injected intramuscularly.

Operation.—A long seventh interspace incision was made, the eighth rib was divided posteriorly and the rib-spreader inserted. Adhesions of the upper lobe made intrapharyngeal pressure unnecessary. Thin, tough adhesions to the chest wall and diaphragm were encountered in the middle and lower lobes and these were divided with knife and scissors. There was very little hemorrhage. In the anterior lower edge of the lower lobe there were spots of atelectasis, bluish

in color. When the lobe had been almost completely freed it was found to be dense and hard—almost tumorlike in consistency—the greater part of the disease being in the posterior part. A hole was cut in a large piece of rubber dam and through the opening the diseased, isolated lobe was drawn in order to prevent reformation of adhesions. A small posterior resection of the eighth rib was made and the wound was closed in layer sutures, three pericostal chromicized catgut sutures approximating the ribs. No drainage.

Post-operative Course.—There was a reaction temperature of 102 plus. The patient's condition was apparently good. His pulse was about 115 but of good quality. The sutures were removed three days post-operative and a number of pus foci were found beneath the muscle sutures. A wet dressing was applied. Fluoroscopy on the fourth day post-operative showed a perfectly clear upper lobe with a shadow in the lower half of the chest but no displacement of the heart. This was interesting as the physical examination showed the apex far to the left of normal. The left chest was clear. On the fifth day the pulse became rapid and thready. There was no cyanosis. The wound was dressed and an opening made between the ribs into the chest, evacuating some very bloody serum but no clots. He suddenly collapsed and died.

A wound examination revealed no infection in the pleural cavity, no large quantity of bloody serum. The upper lobe of the right lung was normal; the lower lobe showed multiple abscesses with bronchiectatic areas and very large lymph-nodes in the hilum.

CASE XXIV.—*Bronchiectatic Lung Abscess from Foreign Body—Right Lower Lobe Extirpation.* This case has been reported in full in the ANNALS OF SURGERY for July, 1916. This is merely a very brief abstract.

Francis W., age three and three-quarters years, had a chronic gangrenous, diffuse bronchiectasis limited to the right lower lobe following the aspiration of some partly masticated nuts. Doctor Yankauer had succeeded in removing most of the fragments through the bronchoscope but without curing the condition. The patient's general condition was very poor. There was much spasmodic cough and foul expectoration.

On February 27, 1914, Doctor Branower gave ether by the intrapharyngeal method and I performed complete lobectomy through a seventh intercostal incision without dividing a rib. There was complete recovery and the patient has remained well and has developed symmetrically.

CASE XXV.—*Chronic Suppurative Pneumonia of Right Lower Lobe—Lobectomy.* This case has been reported in the ANNALS OF SURGERY for July, 1916. Following is a brief abstract of his history. Lawrence F., Hospital Accession No. 31,838, age eight years, was admitted to the service of Doctor Koplik of Mount Sinai Hospital on February 27, 1915. Seven months before admission pneumonia, followed in two or three weeks by a second attack. Cough persisted. Four days before admission fever, cough, and occasional vomiting. The child had gained weight continually during the seven months before admission. In this respect he was abnormal, probably suffering from some form of dyspituitrism. The respirations were thirty-two to sixty-four; the pulse 100 to 144; the temperature 100° to 104.8°.

X-ray examination showed the right lower lobe almost solid and sharply marked from the remainder of the lung which appeared healthy.

On March 1st he was aspirated in the right posterior axillary line and one-half a drachm of pus was said to have been obtained. I first saw him the following day. A diagnosis of pulmonary suppuration was made and on March 4, 1915, I operated in intratracheal anæsthesia, administered by Doctor Branower. Three minims of Magendie's solution had been ordered for this patient, to be given three-quarters of an hour before operation.

Operation.—Through a long seventh interspace incision without cutting ribs the lobe was extirpated. Small resection of eighth rib for drainage.

Post-operative Course.—The operation was well borne with very little loss of blood. The pulse at its conclusion was 140 and the color pink and good. Soon after the patient went to the ward the respirations dropped to about ten and were extremely irregular, although the heart was beating 120 and strong. There was cyanosis and the patient looked dangerously ill. Doctor Branower made artificial respiration by intrapharyngeal insufflation and with the aid of this and one-three hundredth grain of atropine, he revived. It was later found that one-fifth of a grain instead of one-tenth of morphine had been given. The day after the operation the respirations were sixty, the pulse was 145, but the condition did not appear dangerous. Convalescence was in this case unimpeded, although on March 14th the temperature rose to 105.2° without explanation. He was discharged well on May 18th with some contraction of the right side. This deformity rapidly disappeared and four and one-half years later he was perfectly symmetrical, well and strong.

CASE XXVI.—*Suppurative Bronchiectasis—Two Lobe, One Stage Lobectomy—Death.* Sarah G., Hospital No. 168,034, six and one-half years old, was referred to my service at Mount Sinai Hospital by Doctor Koplik on November 27, 1916. She had had measles at one year of age and whooping-cough followed by pneumonia two and one-half years before admission. Chicken-pox and pneumonia seven months before admission. The illness for which she was brought to the hospital was supposed to have begun two and one-half years before at the time of her whooping-cough pneumonia. The outstanding feature of this case was cough, with expectoration, and fever. Frequently the coughing, which was paroxysmal, was followed by vomiting. The expectoration was extremely foul. The fingers were clubbed. On examination the right lung showed dulness beginning just below the angle of the scapula with amphoric breathing at the right base. The urine was negative. The blood showed 3,400,000 red cells; 7200 white cells; polymorphonuclears fifty-two per cent.; lymphocytes thirty-eight per cent.; basophiles two per cent.; eosinophiles three per cent.; myelocytes one per cent.; mononuclear lymphocytes four per cent.; hæmoglobin seventy-two per cent. On admission the temperature was 99.8°; pulse 100 and respirations twenty-four.

X-ray examination showed dense shadow at the right apex. Peculiar formation of dense shadow in lower lobe.

Bronchoscopy by Doctor Yankauer revealed the right bronchus pressed upon by something from without and pus exuding from it. There was also pus from the left main bronchus but Doctor Yankauer thought this might have run in from the right. It was not possible to enter the right bronchus.

This was considered a case for exploratory thoracotomy and on November 27th I operated, Doctor Branower administering nitrous oxide and ether by the intrapharyngeal method. Doctor Ware was first assistant.

Operation.—Through a long right seventh interspace incision the exploration showed the middle lobe to be normal and larger than usual. The right upper lobe was grayish and firm in consistency. The seventh, sixth and fifth ribs were now divided posteriorly and ample space was obtained A few adhesions were divided and the right lower lobe was crushed with a clamp a little beyond the hilum. The clamp was then removed, a series of catgut suture ligatures were put in and the lobe cut away. It was then found that the lower lobe was in quite as bad a condition as the upper and it was removed by the same method. The ligatures of the upper lobe were cut short; those of the lower lobe were left long and were fastened to the chest wall to steady the mediastinum. There was little hemorrhage, only one vessel in the hilum of the lower lobe requiring separate

ligation. A low posterior stab wound was made for drainage. The time of the operation was fifty-five minutes.

Post-operative Course.—The operation was followed by considerable shock, but the patient recovered quickly and in less than an hour was wide awake, perfectly conscious, and asking for Seltzer water. For four days there was steady improvement. The usual foul discharge from the sloughing stump appeared and most of this was drained through the lower opening by the use of a suction apparatus. At the end of the fourth day following the operation I had great hope for a recovery, but at six o'clock on the morning of the fifth day, having been left alone by her special nurse with the side of the crib down, the child fell out of bed. At once there was shock, cyanosis, irregularity of the pulse, and for the next eight hours sinking until she died twelve hours after the accident.

It is by no means certain that recovery would have taken place in any event, but the immediate change in condition after the accident causes me to believe that this shock had much to do with the fatal termination.

Case XXVII.—*Pneumonic Lower Lobe Lung Abscess (Suppurative Pneumonitis)—Extirpation of Left Lower Lobe—Death.* Joe S., twenty-eight years old, was transferred from the Medical Service of Mount Sinai Hospital on July 15, 1919, and on the same day I operated. Eight weeks before he had had a sharp pneumonia and six weeks before he had begun to expectorate large quantities of fetid sputum. His temperature had varied from subnormal to 104°, but was running more nearly normal when I saw him. His general condition remained good and there was no clubbing of the fingers. Bronchoscopy by Doctor Yankauer showed secretion from the upper and lower lobes. X-ray examination showed a large abscess with infiltration occupying about the middle of the chest, so that it was difficult to make sure whether both lobes were diseased or not. He had been prepared with digitalis for two days previous to his transfer.

Operation.—In local anæsthesia, a long seventh interspace incision was made, the pleura opened and a large part of the eighth rib was resected. Because of distress due to mediastinal motion, the operation was then continued in general anæsthesia by the intrapharyngeal method (Doctor Branower). Both lobes were found to be involved and the abscess firmly adherent to the posterior chest wall. Adhesions to the diaphragm were found everywhere on the lower surface of the lower lobe and after releasing them the pedicle was easily loosened and cut off behind chain ligatures of chromicized catgut. This was not difficult because of the absence of the dense infiltration ordinarily encountered here. The stump and raw posterior chest wall were carbolized. Two other openings were made with small resections of rib for drainage by tube, one in the lower part of the chest and the other in the upper end of the wound where the long ligatures also protruded. The main wound was closed, burying the sutures and upper tube. Lower drainage wound closed airtight around the tube, the end of which was carried beneath the surface of lysol solution under the bed.

Post-operative.—No shock followed the operation, but a large amount of bloody discharge came away through the tube. The pulse gradually rose to 108, but was of good quality. There was some abdominal distention, but no vomiting. Two days afterward I was obliged to leave town, and on the third day post-operative death occurred from sudden heart failure with œdema of the lungs.

Case XXVIII.—*Suppurative Bronchiectasis—Two-stage Lobectomy—Death.* The following is the first case in which I performed lobectomy in two stages. This was after I had been convinced by Dr. Samuel Robinson of the advantage of securing adhesion between the healthy lobe and the chest wall before removing the diseased lobe. This principle appears surgically sound and from the standpoint of the anæsthesia should add much to the ease and safety of the operation.

K. G., Hospital No. 168,297, a man thirty-two years old, was admitted to

Mount Sinai Hospital on November 22, 1916. From the age of twelve he had been in the habit of drinking from eight to ten glasses of beer a day; otherwise his history was unimportant. The pulmonary condition for which he sought relief began about a year before, following an attack of influenza. The principal symptom had been cough, with thick, yellowish expectoration, often colored with blood. Five months before admission there began a series of severe pulmonary hemorrhages, the last one seven weeks before. In spite of climatic treatment and good care in an institution his condition became steadily worse. There appeared pain in the right upper thorax, especially on coughing, and there were attacks of vomiting. There were signs of consolidation in the right upper thorax running down to the middle of the chest. The urine showed nothing abnormal. The blood-pressure was 105 over 65. Numerous examinations of the sputum failed to reveal tubercle bacilli. Fever was moderate, pulse on admission ninety-six, respirations twenty-four. Wassermann blood examination was negative. Complement fixation test for tuberculosis was negative.

X-ray Examination.—The X-ray showed dark infiltration from the right apex to the interlobar fissure, where it was sharply limited. The appearances were those of pneumonic infiltration which is often associated with bronchiectasis.

Bronchoscopy.—On November 28, 1916, Doctor Yankauer found by the bronchoscope that secretion was coming from the upper lobe branch of the right bronchus, but this branch could be entered only a short distance because of swelling of the mucous membrane. The middle and lower lobe branches were dilated to twice their normal size but contained no secretion. The left bronchus was normal.

Operation.—I operated on December 7, 1916. Doctor Branower administered the anæsthetic (ether, nitrous oxide and oxygen) by the intratracheal method. An incision was made in the seventh interspace over healthy lung and the rib-retractor put in. The X-ray findings were corroborated and there were dense adhesions of the upper lobe of the lung to the chest wall, the lower lobe being free. The lower lobes were now brushed briskly with gauze, the parietal pleura was wiped with gauze and then brushed with tincture of iodine and the chest was closed by suture without drainage, while the lung was expanded by the intratracheal pressure.

It was hoped that this treatment would cause adhesions to form where they were desired. The wound healed by primary union without reaction and on December 18, 1916, I performed the second stage of the lobectomy, Doctor Branower again administering the anæsthetic by inhalation.

The seventh, sixth and fifth ribs were divided close to their angles through a vertical incision connecting with the former operative wound. The rib-spreader was put in and at once it was seen that sufficient adhesion had formed to hold the lower lobe to the chest wall, simplifying the anæsthesia. The middle lobe was firmly adherent anteriorly and its appearance and texture on palpation appeared normal. The upper lobe was densely adherent to the anterior chest wall and was not all diseased, but it was soon found that the entire lobe would have to be sacrificed because of disease near the hilum. The pedicle was cartilaginously hard and could not be crushed even by a powerful clamp, which had been made by Doctor Yankauer and which worked on the letter-press principle. The operation was continued with great rapidity, quickly peeling the lobe from the chest wall, ligating the pedicle with silk and ablating it in the usual manner. The stump was carbolized. A drainage opening was made posteriorly by a small seventh rib resection. The chest was entirely closed so that there should be as little immediate respiratory embarrassment as possible. Doctor Branower inflated the lower and middle lobes of the lung just as the last sutures were tied.

Post-operative Course.—The pulse was of excellent quality and about 120 in rate; respirations thirty. The temperature was normal until December 20th, when it rose in the evening to 103°, and on the fourth day the wound was dressed without anæsthetic, the patient sitting up. There was fetid discharge which had oozed out of the wound between the sutures. The wound in the chest wall was at once widely opened and packed with iodoformized gauze. For the first post-operative thirty-six hours the cough, which had been constantly present before, disappeared completely. Then it recurred with slight expectoration. We found it impossible to sterilize the wound and impossible even to check the sloughing which had begun under the cutaneous stitches. The case resembled one of those which were seen so often during the War of gas gangrene of the chest wall and after a noble fight the patient died of sepsis on December 27, 1916, nine days after the second stage of his operation.

Remark.—The two-stage method can not be blamed for the death in this case, but probably the closure of the skin by suture made the propagation of the anaërobes more rapid. It is from this case that I came to the conclusion not to suture the skin after even the simplest lobectomy. The discussion of the relative value of the one- and two-stage methods is taken up elsewhere in this paper.

Case XXIX.—*Suppurative Bronchiectasis of Right Lower and Middle Lobes —Two-stage Lobectomy—Death.* Gussie P., twelve years old, was admitted to Mount Sinai Hospital on January 31, 1921, with a temperature of 99.8°, pulse of 104 and respirations twenty-six. She had coughed since she was three days old. There was considerable thick, green sputum, especially in the morning, and there was pain in the lower right chest. Physical examination showed dulness and broncho-vesicular breathing with moist râles over the lower right lobe. There was no clubbing of the fingers and the expectoration was not fetid. An operation for nasal polypi had been performed. Bronchoscopy by Doctor Yankauer revealed purulent secretion from all the branches of the right bronchus and what was considered overflow coming from the left. X-ray examination showed infiltration with consolidation in the right lower lobe.

An operation preparatory to lobectomy was performed on February 24, 1921, Dr. Ira Cohen, first assistant. Intrapharyngeal anæsthesia by Doctor Eliasberg. of mucopus and during he anæsthesia about twenty ounces were discharged.

At request just before the anæsthetic the patient coughed up about ten ounces of mucopus and during the anæsthesia about twenty ounces were discharged.

Procedure.—A long seventh interspace incision entered the chest and retraction was made with the rib-spreader. The lower lobe, while not dusky in color, was of a peculiar appearance, showing numerous minute nodules over its surface which were easily detected by sight as well as by touch, so that the viscus looked as if infiltrated with many metastases. The middle lobe was less visibly involved and the upper lobe appeared normal to touch and sight. A long section of the eighth rib was now removed for the sake of gaining space at the next operation. A strip of iodoformized gauze, single thickness, was placed between the upper lobe and the chest wall so as to make adhesions, and the wound was closed in layers with suture of muscle but not of skin.

Before tying the last suture an attempt was made to distend the lung but with doubtful success.

An X-ray picture taken March 9th showed a clear lung at the left side and with the general condition of the patient apparently good the lobectomy was undertaken. Nitrous oxide and oxygen, with a little ether, administered by Doctor Branower. Dr. Ira Cohen assisted at the wound.

Procedure.—The wound was quickly reopened and two more ribs were cut upward at the posterior angle. The rib-spreader was inserted. Adhesions had formed between the upper lobe and chest wall posteriorly. The lower and middle

lobes were covered with lymph and densely adherent to the surrounding parts. The lower lobe was separated bluntly from the diaphragm and from the upper and middle lobes and was extirpated beyond numerous transfixion ligatures of strong twisted silk. The child's condition was not good enough to warrant extirpation of the middle lobe also. The ligatures were left long and were tied together. The ligatures and stump which had been carbolized were brought through a perforated rubber dam which was loosely packed with iodoformized gauze. The ligatures, packings and rubber dam were brought out from the posterior part of the wound, the ligatures being fixed with a safety pin so as to steady the mediastinum. Considerable blood was lost and during the remainder of the operation the child received a saline infusion intravenously. The wound was now closed by three pericostal chromicized catgut sutures and muscle sutures. A few tubes were placed in the costophrenic sinus anteriorly for further drainage. The second wound was packed with iodoformized gauze.

Post-operative Course.—Immediately after the operation 250 c.c. of citrated blood were transfused. An hour after the operation the temperature had risen to 106 degrees, and in spite of the steadying of the mediastinum there was practically a sucking wound. This was overcome by firm strapping and the respirations became much easier. The child never reacted, however, and there was great rattling in the throat on respiration. Death occurred seven hours after the completion of the operation with hyperpyrexia of 108 degrees.

Post-mortem.—A wound inspection showed surgically perfect conditions in the right chest. The middle lobe, however, was bronchiectatic. The upper lobe was erected normally. The left lung was pneumonic and showed small areas of disease, probably bronchiectatic in character.

Pathological diagnosis by Dr. F. S. Mandlebaum.

Case XXX.—*Infected Mediastinal Dermoid Cyst—Carcinoma of Cyst Wall—Secondary Bronchiectasis—Resection of Right Lower Lobe—Drainage of Cyst—Death.* Miss E. R., thirty years old, a patient of Dr. A. Peskind, of Cleveland, had for many years expectorated foul pus and for about seven years the quantity was fully twelve ounces a day. There were occasional hæmoptyses. A drainage operation a year before I saw her had not benefited her and the wound had closed, but even while it was open and draining the cough continued uninfluenced. She consulted me on September 22, 1921, a well-nourished but slightly cyanotic girl, a scar just behind the right mamma, fingers clubbed, dullness and râles in the right lower chest. The X-ray showed a peculiar shadow in the right lower thorax which we interpreted as a bronchiectasis. The possibility of suppurating dermoid had been also considered, especially by Doctor Neuhof. Bronchoscopy by Doctor Yankauer revealed much pus coming from the dilated right lower bronchus. The patient was prepared for operation. Blood-pressure 115–84. Operation September 26, 1921, Doctor Branower anæsthetizing (intrapharyngeal) with gas, oxygen and ether and Doctor Neuhof assisting at the wound. The patient was given sodium citrate intramuscularly.

Procedure.—A long sixth interspace incision with resection of the seventh rib was made. The entire lower half of the chest was filled with adhesions, obliterating the pleural cavity. Orientation was effected with difficulty and the right lower diseased and shrunken lobe, the size of a small orange, was resected beyond numerous transfixing ligatures. On section the pedicle showed greatly dilated bronchi. The patient's condition being excellent and only a moderate loss of blood having occurred, a further exploration was made, when a cavity containing pus and sebaceous material with hair was opened. It was fully the size of a lemon and contained a large nipple-like mass of embryonal skin attached to the mediastinal region. This was cut away beyond ligatures, the cavity packed with

iodoformized gauze and the usual drainage of the stump accomplished. There was no danger of mediastinal flapping because of numerous adhesions.

Post-operative Course.—The operation lasted fifty minutes and the patient's condition at its termination was encouraging. Pulse-rate 120; fair quality. I felt that I had every reason to hope for a recovery. As soon as the patient was transferred to the stretcher, however, there was sudden collapse with weakness of the pulse, and, although she regained consciousness, had no pain and was able to drink water, she died of shock ten hours after the conclusion of the operation.

CASE XXXI.—*Bronchiectatic Lung Abscess; Middle and Lower Lobes—Major Thoracotomy and Exploration.* Charles J., Hospital No. 197,461, thirty-seven years old, was admitted to Mount Sinai Hospital December 21, 1919. About a month before had been operated upon for gastric ulcer and appendicitis and there supervened pneumonia with hiccough. Then came cough, bloody sputum and pain in right chest. Loss of sixteen pounds. Night sweats, etc. Physical examination showed dulness in right chest posteriorly with diminished voice and breathing. Blood showed 10,000 white cells and ninety-two per cent. polymorphonuclears. Fluoroscopy showed limitation of movements of the right diaphragm and the plate was interpreted as pneumonia of right lower lobe. Bronchoscopy by Doctor Yankauer showed mucopus from the middle lobe bronchus and from second branch lower lobe bronchus. Lavage was done once, but patient refused further bronchoscopical treatment. In spite of treatment under Doctor Manges, disease progressed and exploration with probable lobectomy was decided upon.

February 16, 1920, at first-stage operation, upper lobe found free but dense indurated mediastinal portions of middle and lower lobes were seen. Diseased lobes partly mobilized and upper lobe prepared by gauze packings for second stage.

Second stage never performed because of poor reaction following first stage. Procedure was difficult and one and one-quarter hours were consumed. After operation there was severe shock. Thirty hours later citrate transfusion of 400 c.c. of blood. Three days after operation the wound was reopened. Convalescence was slow. There was much foul discharge but patient gradually recovered, the large wound filling by granulation. About two months after operation patient was discharged still unhealed, but there was final recovery, and he is apparently well at this writing.

HISTORICAL SUMMARY

Gluck, Schmid, Block, Biondi successfully extirpated lung experimentally about 1884.

Stretton, Tuffier, Doyen, Lowson, Sonnenburg and McEwen resected lung for tuberculosis. (Recovery.)

Lowson removed successfully a tuberculous lung apex the size of "half a fist."

Tuffier delivered a lung apex through an intercostal incision and removed a portion of it experimentally.

Doyen resected the remains of a right lower lobe in which a large hydatid cyst had previously been drained.

Garré excised a lower lobe for bronchiectasis by first resecting a sufficient number of ribs to cause a caving in of chest wall sufficient to permit the delivering of the lobe and extrathoracic treatment of the stump at a subsequent operation.

TABLE OF CASES*

(Pathology by Dr. Aschner)

No.	Name	Age	Sex	Cause	Location of lesion	Type of operation	Pathological anatomy	Complicating pathology	Result	Remarks
1	Mrs. E. M. B. ..	33	F	Post-tonsillectomy infection	Middle lobe	One stage lobectomy	Bronchiectatic abscess	Pneumonitis	Well	1000 c.c. of mucopus per day
2	Mrs. C. M.	28	F	Post-tonsillectomy infection	Upper left lobe	One stage resection of lobe	Bronchiectatic abscess	Pneumonitis	Well	Has gone through severe typhoid fever without lung complications
3	W. A. B.	26	M	Post-tonsillectomy infection	Right lung	One stage sub-total pneumectomy	Bronchiectatic abscess	Pneumonitis interstitial	Well	Patient has apparently permanent incomplete pneumothorax and wears a small tube to prevent recurrent empyema. No symptoms
4	Miss S. K.	16	F	Post-tonsillectomy infection	Right lower lobe	Two stage lobectomy	Bronchiectatic abscess	Pneumonitis interstitial	Death	Shock
5	Miss E. B.	33	F	Post-tonsillectomy infection	Middle & upper lobes	One stage single lobectomy	Bronchiectatic abscess	Pneumonitis	Death	Shock
6	Miss J. K.	32	F	Post-tonsillectomy infection	Right upper and lower lobes	One stage resection of lower lobe	Bronchiectatic abscess	Pneumonitis	Death	Shock
7	Sylvia M.	8½	F	Post-tonsillectomy infection	Right upper lobe	One stage lobectomy	Bronchiectatic abscess	Pneumonitis interstitial	Well	Is studying fancy dancing
8	Rose F.	12	F	Post-tonsillectomy infection	Right lung	One stage pneumectomy	Bronchiectatic abscess	Pneumonitis interstitial	Death	Œdema of opposite lung. See series of radiographic pictures illustrating progress of disease
9	Mrs. J. P.	30	F	Post-tonsillectomy infection	Both left lobes	One stage partial lobe resection	Bronchiectatic abscess	———	Death	Shock. Case actually inoperable because of dense adhesions from previous attempted drainage
10	Miss M. V.	14	F	Post-tonsillectomy infection	Right lower lobe	Two stage lobectomy	Bronchiectatic abscess	Pneumonitis interstitial	Well	Studies fancy dancing
11	Gertrude K.	8	F	Post-tonsillectomy infection	Left lung	Two stage total pneumectomy	Suppurative pneumonitis	———	Death	Septic infection diorrhea. Death 13 days postoperative from hemorrhage from stump
12	Abraham G.	8	M	Post-tonsillectomy infection	Left upper lobe	Major thoracotomy and exploration	———	———	Improvement	Relapse and bronchial fistula; again in hospital
13	Jacob S.	36	M	Unknown	Right lower lobe and part of upper lobe	Attempted extirpation	———	———	Death	———
14	David J.	16	M	Unknown	Middle lobe and part of adjoining lobes	One stage resection of middle lobe and part of adjoining lobes	Suppurative pneumonitis	———	Well	Followed for two years
15	Jacob K.	5	M	Unknown	Right lower lobe	One stage lobectomy	Suppurative pneumonitis	Abscesses	Death	Death probably due to mediastinal flapping
16	Joseph S.	25	M	Unknown	Right lower lobe	One stage lobectomy	Bronchiectasis	Pneumonitis	Death	Death probably from cerebral metastasis
17	Charles G.....	37	M	Unknown	Right lower and middle lobes	First stage of lobectomy	———	———	Death	Septic pneumonia
18	Fannie B.	16	F	Unknown	Left lower and part of upper lobe	One stage lobectomy left lower and part of upper lobes	Bronchiectasis	———	Well	———

19	Mrs. A. M.	26	F	Unknown	Left lower lobe	One stage lobectomy	Bronchiectasis	———	Death	Death probably due to visceral sprue
20	Morris U.	42	M	Aspiration (?) epilepsy	Right lower and middle lobes	Two stage attempted lobectomy	———	———	Death	X-ray failed to show disease in other lung; revealed by post-mortem. No bronchoscopy because of epilepsy
21	J. M. W.	23	M	Congenital (?) later infected	Left lower lobe	Two stage lobectomy	Bronchiectasis	———	Still some cough and expectoration	Case of transposition of viscera
22	Miss Josephine E.	18	F	Unknown	Left lower lobe	One stage lobectomy	Bronchiectasis	———	Convalescent	Nearly well
23	Max L.	16	M	Unknown	Right lower lobe	First stage of lobectomy	———	———	Death	Cardiac failure
24	Francis W.	3¾	M	Foreign body	Right lower lobe	One stage lobectomy	Bronchiectasis	Pneumonitis	Well	———
25	Lawrence P.	8	M	Chronic suppurative pneumonia	Right lower lobe	One stage lobectomy	Suppurative pneumonitis	Miliary abscesses, large bronchi slightly dilated	Well	———
26	Sarah G.	6½	F	Whooping-cough pneumonia	Right upper and lower lobes	One stage lobectomy (2 lobes)	Bronchiectasis	Pneumonitis	Death	Immediate cause of death fall from bed with tearing loose of traction ligature between lung and chest wall
27	Joe S.	28	M	Pneumonia	Lower left lobe	One stage lobectomy	Suppurative pneumonitis	Abscesses	Death	Death probably from pneumonia of opposite side
28	K. G.	32	M	Post-influenza infection	Right upper lobe	Two stage lobectomy	Bronchiectasis	Pneumonitis and bronchial abscesses	Death	Anaerobic infection of wound; death from sepsis
29	Gussie P.	12	F	Probably congenital, later infected	Right middle and lower lobes	Extirpation of lower and middle lobes —two stages	Bronchiectasis	Suppurative broncho-pneumonia	Death	Death with temperature to 108 soon after citrate transfusion
30	Miss E. R.	30	F	Infected mediastinal dermoid cyst	Right lower lobe	One stage lobectomy	Bronchiectasis	Suppurative broncho-pneumonia	Death	Shock. Had diagnosis been made drainage of cyst should have preceded lobectomy
31	Charles J.	37	M	Post-operative aspiration pneumonia	Right middle and lower lobes	First stage of lobectomy	———	———	Apparently well	Second stage not performed because of dangerous reaction following first stage

* For conscience's sake I will mention here one case which is not included in the table because it was a mere exploration, not even an intended lobectomy. It is given here to round out every bit of personal operative experience with this disease which I have had in the period covered by this paper. The patient was a soldier in France who following a mouth operation developed an acute gangrene of the right upper lobe. I exposed the lobe by thoracotomy and the patient expired on the table. It was not a true bronchiectatic case because only a few days had elapsed since his infection.

Heidenhain reported a successful removal of left lower lobe for bronchiectasis. Two previous operations had been performed with drainage of several large bronchiectatic cavities. Rib resections had been performed at each of the preliminary operations. Patient remained with bronchial fistula.

Rehn, Bardenheuer, König, Garré, Trendelenburg and others, tumors of chest wall with removal of greater or lesser portions of lung.

Helferich removed two complete lobes. Patient died seventeen hours post-operative.

Murphy: Unsuccessful attempt to resect lung.

Veerhoogen: Partial resection of lower lobe of left lung for a tuberculous cavity in a man of thirty-five. Patient shown six weeks post-operative. No further data.

Gerulanos: Reports Helferich's case in which middle and lower lobe of right lung resected for breast sarcoma.

Stretton resected upper lobe right lung for tuberculosis successfully.

Friederich: In two cases resected left lower lobe for bronchiectasis in a pneumatic chamber. Both patients died five days post-operatively when bronchial stump gave way and they developed a tension pneumothorax.

Müller resected right lower lobe for tuberculosis in a child. Patient died three weeks post-operative.

Körte resected right lower lobe for bronchiectasis successfully in a boy. Boy still alive four years after operation. No further report.

Kümmel resected an entire lung in forty-eight-year-old man for carcinoma. Patient died six days after operation of œdema of the remaining lung.

W. Meyer, in 1914, made the statement that sixteen cases of pneumectomy for bronchiectasis had been reported in the literature, of which eight were cured or improved and eight died.

Robinson: Five cases of pneumectomy for bronchiectasis with one death. All done in several stages.

First stage consists of subperiosteal resection of ribs.

Second stage opens pleura and if conditions are favorable operation may be completed; if not, resection is done in third stage after packing chest at end of second stage.

In a later paper he reports seven cases with three deaths.

Hitzrot extirpated in stages a right lower lobe for suppurative bronchiectasis with lung abscess. Patient was presented at a meeting of the New York Surgical Society, February 11, 1920.

THE PATHOLOGY OF LUNG SUPPURATION

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Suppurative diseases of the bronchial system and the lungs have received relatively limited pathological study. I do not refer to the suppurative processes associated with tuberculosis, syphilis, and actinomycosis, nor to those consequent upon the breaking down of malignant neoplasms. The gross lesions produced by pyogenic organisms are described chiefly in clinical works. Microscopic details even in pathological texts are scant. A satisfactory classification is lacking and much confusion exists in the terminology employed. In former years our knowledge of the pathology was dependent for the most part upon autopsy material. The disadvantage was that the patient had either succumbed rapidly to a fulminating process, or had lived for some years with widespread extension, secondary processes and efforts at healing. When, therefore, Doctor Lilienthal undertook his series of lobe resections an opportunity to study the lesions under more favorable circumstances was presented. Doctor Wilensky began these studies and they were continued by me after he very generously gave me the material he had collected up to 1918.

It is my purpose at this time to present the results and the more important details of this study.

The infectious agents very evidently may enter the lung in the following ways: 1. Through the air passages. 2. Through the blood-stream, by way of the venæ cavæ and the right heart (embolic lesions). 3. By direct extension from neighboring structures. 4. By traumatic introduction through the thoracic parietes. Whether there is such a condition as primary suppurative pleuritis with secondary invasion of the pulmonary parenchyma by direct or lymphatic extension is still a moot question. We may be sure, however, that just as in peritonitis, primary infection of the serous pleural space and membranes is exceptional. As elsewhere in the body the factors of virulence on the part of the infectious agents and of resistance on the part of the invaded tissues and the attacked individual determine the pathological lesion. Certain aseptic lesions such as infarcts, and hæmatomas resulting from subcutaneous injuries of the lung predispose to successful invasion by pyogenic organisms through the air passages or the blood-stream. Certain inflammatory processes such as pneumonia and influenza, ordinarily non-suppurative, are prone to secondary invasion by virulent pyogenic bacteria.

Whether or not suppuration will assume the physical characteristics which we call gangrene depends upon the kind of microörganisms (*e.g.*, anaërobes), upon the extent of thrombotic processes in the affected tissues, and upon

the type of individual affected (*e.g.*, diabetic, marasmic, and cachectic individuals are prone to gangrenous processes).

It is of the greatest importance to remember that once pulmonary suppuration has been established it is very prone to spread to other parts of the lungs by way of the air passages and the lymphatics. A simple purulent process, moreover, may become gangrenous by the advent of factors enumerated above. Embolic lesions involving distant organs, notably the brain, the bones, and the joints, may occur by way of the pulmonary veins and the general circulation. The relatively frequent incidence of such complications in the empyemata of the recent influenza epidemics constitutes strong evidence of the origin of these empyemata from foci of pulmonary suppuration.

The specimens removed by Doctor Lilienthal fall into the following three groups:

1. Bronchiectasis (general)* ..... 10 cases
2. Bronchiectatic abscess ..... 10 cases
3. Suppurative pneumonitis ..... 4 cases

From what has been said it is apparent that secondary changes occurring in the course of the disease occasionally make it difficult to classify the individual specimen. Thus a case of general bronchiectasis may be complicated by interstitial or suppurative pneumonitis, or, as a result of ulceration, by small bronchiectatic abscesses. A case of suppurative pneumonitis is apt to show some dilatation of the bronchi due to the accompanying infection of the bronchial walls, or the fibrosis of reparative processes. A bronchiectatic abscess is accompanied by pneumonitis, which in turn causes local bronchiolar dilatation. Nevertheless careful gross and microscopic study of the specimen will reveal its essential type.

A fourth group is that of Extrabronchial Abscesses. These occur in the parenchyma of the lung from several causes. An aseptic infarct or traumatic hæmatoma results in such a lesion when secondary infection takes place. Septic embolism of the lung produces parenchymatous abscess. In pneumonia, both lobar and lobular in type, the central part of a massive exudate may break down from impairment of the blood supply by pressure or thrombosis. If the causative bacteria are ordinarily pyogenic, or if the individual's resistance is low, or if secondary invasion by pus-producing organisms supervenes, smaller or larger areas of suppuration occur. Abscesses complicating lobar pneumonia are likely to be single, large and central. Those complicating lobular and broncho-pneumonia and those due to septic embolism tend to be multiple, small and peripheral. The broncho-pneumonia following influenza is especially prone to develop small peripheral abscesses, which often infect the pleural cavity by extension or rupture.

The tendency of abscesses of this group is to break into either the bronchial system or the pleural cavity, and nature attempts to cure them in these ways.

* By general bronchiectasis is meant dilatation of all the bronchi and bronchioles of one or more lobes of the same lung, in contradistinction to universal, by which is meant diffuse involvement of both lungs.

It is apparent that the specimens of suppurative pneumonitis contain extrabronchial abscesses and that the borderline between the third and fourth groups is not very sharp. The term extrabronchial abscess should be used perhaps to designate those due to strictly localized suppurative pneumonitis.

Bronchiectasis (ten cases).—By this is meant more or less uniform dilatation of the bronchi and bronchioles. The process may be confined to one or more lobes of a lung, in which case it is designated general. It may involve both lungs extensively, in which case it is designated universal. Of the ten specimens examined, five involved the left lower lobe; two the right lower lobe; one the right lower and middle lobes; one the right upper lobe; one the right upper and lower lobes.

Etiology: For this reliance must be partly placed upon the clinical history. In three cases it is unknown. In two there is a history of extensive disease of the paranasal sinuses. Influenza, pertussis, and some form of pneumonia appear to be the causes in three. In one, foreign body aspiration is recorded. In another (Case 30) the pressure upon the bronchi by a mediastinal dermoid resulted in bronchiectasis. The wall of the cyst showed elements derived from the three embryonal layers and beginning carcinomatous changes were present in the glandular elements of entodermal origin. Narrowing of the lumen by intrabronchial tumors can produce the same condition. In two clinical cases of Doctor Yankauer's fibromas growing within a bronchus have caused bronchiectasis and suppuration. A polypoid lymphosarcoma arising from the submucous lymphoid tissue of a secondary bronchus was found post-mortem in another case.

Gross pathology: The lobe usually appears smaller than normal in size, dark blue or purplish in color. The pleural surface may be smooth and glistening, or dull and thickened, depending upon the amount of parenchymatous disease, and upon whether a one- or two-stage operation was performed. The lung crepitates less than normally and has a fine, nodular or shotty feel caused by the numerous terminal dilated bronchioles. The line of resection shows ten to twenty bronchial branches from one to two centimetres in diameter from which pus of varying consistency and odor exudes. The walls are thick and dense, the mucosa redundant, red or gray and soggy. They can be followed out to the periphery of the lung where they frequently end in small sacculations. In some of these saccules the walls are ulcerated and terminal abscesses have formed. On longitudinal section of the lobe the richness and prominence of the dilated thickened air passages contrasts with the reduced parenchyma. The latter appears atelectatic with increased connective tissue, and may show areas of exudation or suppuration in the vicinity of the bronchial branches or at their terminations.

Microscopic pathology: The bronchial branches and bronchioles form a large part of the section. The mucous membrane surface is tremendously increased not only by the general dilatation, but by the throwing up of numerous rugæ producing a papillary appearance. The

layers of columnar ciliated epithelium are increased in number so that a relatively small radicle has an epithelial lining four or five cells deep.

The lumen contains an exudate made up of mucus, desquamated epithelia, lymphocytes, and varying numbers of polymorphonuclear leucocytes. The subepithelial stroma, the muscularis, and in more advanced cases the fibrosa are diffusely infiltrated by round cells and fibroblasts. Round cells are seen in the epithelial layer also. The peribronchial tissues show either inflammatory infiltration or increase of connective tissue and from the vicinity of the bronchioles thickened interlobular septa radiate. Elastica stains show that the normal elastic laminæ are either entirely absent, or represented by strands frayed and broken by the inflammatory tissue.

The parenchyma in four specimens shows only a condition of partial atelectasis, the alveoli being small and their walls somewhat thickened. In three specimens a pneumonitis is present, most marked about the bronchioles and consisting chiefly of interstitial fibrosis, lymphoid foci, alveolar exudation and desquamation. In two the process is more acute and areas of suppurative pneumonia surround the bronchioles, the parenchyma in these areas being infiltrated with pus cells. In two cases the terminal saccules show partial destruction of the epithelium leaving a cavity lined chiefly by inflamed granulation tissue. In some the remaining epithelium is a single layer of cuboidal cells, but in others it appears flattened and stratified, suggesting metaplasia. The destruction of elastic elements in the parenchyma varies directly with the extent of pneumonitis.

To summarize, the chief lesions are dilatation of the bronchial system of the lobe, enormous increase of mucosal surface, round-cell infiltration of the stroma and muscularis, destruction of the bronchial elastic laminæ.

Bronchiectatic Abscess (*ten cases*).—By this is meant a distinct type of pulmonary suppuration, which in this series has followed operation for removal of the tonsils and adenoids under general anæsthesia in every instance. It is remarkable that the constancy of the pathological lesion is paralleled by uniformity in the clinical history of the patients; namely, the development of fetid expectoration after an incubation period of thirteen or fourteen days following the operation. The distribution of the lesion is as follows: Two of the left lung, eight of the right; five are primarily in the lower, two in the middle, and three in the upper lobes.

Gross pathology: One-third to one-half of the lobe appears rigid and prominent, with a grayish yellow color of the involved portion and with thickened pleura. In a few cases the whole lobe presents this appearance. The line of resection shows four or five large bronchial branches, thick walled, somewhat dilated and exuding thick pus usually of foul odor. On tracing out the secondary bronchi one of them is found to lead into an irregular cavity of varying size and shape containing pus and necrotic material. From this cavity smaller bronchial radicles can be followed in various directions toward the periphery of the lung. Other bronchi traced

out from the line of resection show some dilatation and purulent content caused either by spilling over of pus into them from the essential lesion, or as a result of mechanical factors such as compression or displacement by the primary lesion and its secondary pneumonitis. In a few cases the primary lesion appears in the course of the main bronchus of the lobe and it has been entered in the course of the resection.

The interior of the abscess cavity presents a varying picture depending upon the age of the lesion, and the extent to which necrosis has gone on. In some the wall is relatively smooth and glistening, in others more or less granular and dull, in the oldest smooth, dull and fibrous. These appearances have a definite microscopic basis which will be described subsequently.

The appearance of the parenchyma on longitudinal section varies considerably with the age and extent of the disease. About the abscess cavity, the bronchial branch leading into it, and the branches passing out of it, the lung tissue is converted into a firm, indurated mass showing dense bands of connective tissue separating grayish yellow raised areas. The parenchyma in the distribution of the other bronchial branches may be fairly normal, markedly congested and friable, or may be the seat of a secondary interstitial or purulent pneumonitis. When the main lobe bronchus is the site of the abscess the whole parenchyma shows the fibrotic lesion.

Microscopic pathology: The pleura covering the diseased lung shows great thickening due to the presence of fibroblasts, numerous capillaries and lymph-vessels with swollen endothelial cells. The parenchyma is traversed by wide bands of connective tissue of varying vascularity and showing areas of round-cell infiltration, plasma cells and fibroblasts. The interalveolar septa are greatly thickened and infiltrated with round cells. The alveoli are reduced in size or completely obliterated by organization of preceding alveolar exudate. Masses of pigment appear in these areas and in the fibrotic septa. Alveoli near the periphery of the lung or in areas outside the distribution of the affected bronchus show a varying amount of interstitial inflammation and exudation containing many desquamated epithelial cells, round cells, and polymorphonuclear leucocytes. The elastic fibres in the most diseased areas are more or less completely destroyed. The blood-vessels frequently show endothelial thickening and hyaline degeneration.

A striking picture is observed in three cases. Islands of numerous duct-like structures, lined by low cuboidal epithelium, some apparently leading into alveoli, are seen in areas of dense fibrosis and remind one of the proliferation of the bile passages in cases of portal cirrhosis. In one of the earlier cases this feature was so prominent as to suggest malignancy.

Cross-sections of bronchial branches show round-cell and leucocytic infiltration, the subepithelial layer being converted into a vascular granulation tissue. The peribronchial connective tissue is similarly infiltrated. The amount of destruction of the elastic lamina depends upon the degree of infiltration of the wall.

The greatest interest centres about the wall of the abscess cavity. Sections taken through the bronchus and the beginning of the cavity show a remarkable transition from columnar ciliated to a stratified squamous epithelium lining the cavity in several specimens. Other sections cut far away from the entering bronchus and only a centimetre or two from the pleural surface show areas in which the granulation tissue is covered by a flat epithelium from one to three cells in depth. In other sections the wall is formed by a dense fibrous tissue beneath which large blood-vessels, and scattered mucous glands are seen, indicating its bronchial origin. In one specimen removed two years after the tonsillectomy the wall was fibrous and thick but smooth and no communication with a bronchus could be determined. Whether the cavity had become sealed off or whether the abscess was embolic and not of the usual type cannot be decided. The clinical onset was the same as in the others.

The presence of the epithelial lining and the gross pathology indicate without doubt that the usual post-tonsillectomy lung infection begins as a localized lesion in a bronchus. That the septic embolic lesion may occur cannot be denied. That a suppurative pneumonitis can occur is proven by a case in the third group, but a clinical course and pathological anatomy are entirely different. For the production of a localized bronchial lesion we must assume the aspiration of a piece of infected tissue or blood clot. The aspiration of mouth secretion or fluid blood, it seems to me, would produce a diffuse lesion such as is described by the term Suppurative Pneumonitis.

The presence of an epithelial lining in the cavity is one of the factors in preventing spontaneous healing, as is also the extensive fibrosis in the parenchyma. The epithelial lining would favor permanent fistula formation if pneumotomy were performed.

Concerning the mechanism in the cases of spontaneous healing no definite knowledge is available, but it must be either a complete epithelialization of the cavity or a total necrosis of the lining membrane early in the disease before fibrotic changes have appeared to prevent collapse of the cavity.

The bacteriological studies have been disappointing because of the great mixture of organisms, and the difficulties of anaërobic work with such mixtures.

Efforts to duplicate the lesion in dogs by means of intratracheal insufflation of pieces of tonsil and adenoid, pus from clinical cases, and cultures of anaërobes have been unsuccessful. Blood aspirated from the dog's femoral vein was injected with tonsil tissue and anaërobes without producing suppuration.

Suppurative Pneumonitis.—By this is meant a pathological condition of rather varied appearance involving one or more lobes and the result of widespread infection by way of the air passages. The lesion may be primarily suppurative as in cases of submersion and aspiration, or secondarily suppurative as in cases of broncho-pneumonia following influenza.

Four specimens belong in this group. One consists of left upper and lower lobes of a child who developed grave pulmonary signs a few days after a tonsillectomy. The lobes are large, heavy and reddish on the surface. On section numerous bronchial branches exude pus. The parenchyma is yellowish brown and gray, and studded with miliary foci of suppuration. The whole parenchyma is pus-soaked. This does not in any way resemble the pathology in Group 2, and the clinical history is very different.

A second specimen is from a case of pneumonia following a gall-bladder operation. Here the process is of longer duration. The bronchi show thick infiltrated mucosa. The parenchyma show areas of interstitial and organizing inflammation, and other areas of purulent infiltration and miliary abscesses, due to breaking down of the alveolar septa. One abscess cavity the size of an egg communicates with a bronchus, and its wall consists chiefly of vascular granulation tissue. It shows, however, several areas covered by flattened epithelium, three or four cells deep.

A third specimen, supposedly pneumonic in origin, shows several gangrenous cavities communicating with the bronchial tree, and a parenchyma fibrosed and infiltrated. Cuboidal cells line the cavities in part.

The microscopic sections indicate that abscesses in these cases may originate in terminal bronchioles, or in the parenchyma with secondary perforation into the bronchial tree. Secondary dilatation of the bronchioles was more noticeable in a fourth specimen, a case of broncho-pneumonia after pertussis.

Doctor Wessler believes that certain post-pneumonic gangrenes with an incubation period of two weeks are really aspiration abscesses similar to those ascribed to tonsillectomy. While conclusive pathological evidence is wanting at present, it is to be remembered that such cases are either not operated upon at all or they are operated upon only after a considerable period has elapsed, with consequent extensive secondary changes hiding the essential lesion.

SUMMARY

Lung suppurations may be divided into:

1. Bronchiectasis, a general disease of the bronchi in one or more lobes.
2. Bronchiectatic abscess, a localized suppurative process in the course of a bronchus, and thus far observed only in post-tonsillectomy cases.
3. Suppurative pneumonitis, a diffuse purulent process.
4. Extrabronchial abscess, a localized purulent process.

Certain interesting histological changes have been observed:

1. Metaplasia in bronchial epithelium.
2. Epithelial lining of bronchiectatic abscess and some smaller abscesses of Group 3.
3. Proliferation of smaller bronchioles and air passages resembling proliferation of the bile passages in portal cirrhosis.

LITERATURE

Apcott: A Review of Some Recent Work on Lung Surgery. Practitioner, Lond., 1911, vol. lxxxvi, pp. 837–847.

Batzdorf: Die Chirurgische Behandlung der Bronchiektasie. Centralbl. f. d. Grenzgeb. d. Med. u. Chir, Jena, 1912, vol. xvi, pp. 1–18.

Biondi: Lungenexstirpation bei experimentell logalisierter Tuberkulose. Wiener med. Jahrbücher 1884. H. 2 u. 3.

Bock: Experimentelles zur Lungenresektion. Deutsch. med. Woch., 1881, No. 47, S. 634.

Courmont: Sur la pneumectomie experimentelle avec survie prolongée. Compt. rend. Soc. de Biol., Par., 1912, vol. lxxiii, p. 503.

Danielson: Beiträge zur Lungenchirurgie. Bronchotomie und Lungenresektion. Beitr. z. Klin. Chir., 1908, vol. lx, p. 94.

Doyen: Révue de therapeutique Médico-chirurgical, 1898, vol. lxvi, p. 38.

Ekehorn: Zur Lungenchirurgie. Nord. Med. Ark., Stockholm, 1913–14, 3F., vol. xiii, No, XI. pp. 1–9.

Friedman: Lungeiterung und ihre operative Behandlung. Centralbl. f. d. Grenzgeb. d. Med. u. Chir., Jena, 1913, vol. xvii, pp. 155–86.

Friedrich: Die Chirurgie der Lungen under Gleich-zeitiger Mitteilung von Versuchen zur Lungen-physiologie und von eigenen operativen befahrungen. Arch. f. Klin. Chir., 1907, Bd. 82, S. 1147.

Ueber den Raunmausgleich in der Brusthöhle nach einseitiger Lungenamputation, nebst Bemerkung ueber das operative Mediastinalemphysem. Verhandl. der deutsch. Gesellsch. f. Chir., 37 Kongresz, 1908, vol. ii, S. 571.

Garre u. Quincke: Lungenchirurgie, June, 1912.

Gerulanos: Eine Studie über den operativen Pneumothorax in Anschulsz an einen Fall von Lungenresektion wegen Brustwandsarkom. Deutsch. Ztschr. f. Chir., 1898, Bd. 49, S. 497.

Giertz: Ueber Exstirpation von Lungen und Lungenlappen mit Versorgung der Bronchialstumpfes durch frei transplantierte fascia. Zentralbl. f. Chir., Leipz., 1914, vol. xii, pp. 1433–35.

Gliuboff: Removal of Part of Lung. Sibirsk Vratch. Gaz. Irkutsk, 1912, vol. v, pp. 220–222.

Gluck: Experimenteller Beitrag zur Frage der Lungenexstirpation. Berl. Klin. Wchnschr., 1881, Nr. 44, S. 645.

Green, N. W.: Lung Abscess. Surg., Gyn. and Obst., 1906, vol. ii, pp. 512–537.

Grégoire: Resection partielle du poumon pour abscès. Bull. et Mém. Soc. de Chir. de Par., 1918, vol. xliv, 2, pp. 1435–39.

Hansen, P. N.: Surgical Treatment of Bronchiectasis. (Report of four cases of bronchiectatic cavities treated by resection of the lung.) Nord. Med. Ark., Stockholm, 1917, vol. l, afd. 1, No. 13, pp. 1–24.

Heidenhain: Ausgedehnte Lungenresektion wegen Zahlreicher eiternder Bronchiectasien in einem Unterlappen. Verhandl. der deutsch. Gesellsch. f. Chir., 30 Kongresz, 1901, vol. ii, S. 636.

Helferich: Case operated on by Helferich, reported by Gerulanos.

Hellin and Dionys: Die Folgen von Lungenexstirpation. Arch. f. experim. Path. u. Pharmakol., 1906, Bd. 55, S. 21.

Henschen: Brüns Beitr., 1914, Bd., vol. xc, S. 373.

Hitzrot: Annals of Surgery, June, 1920, p. 785.

Kawamura: Experimentelle Studien über die Lungenexstirpation. (Good résumé of exp. literature.) Deutsch. Ztschr. f. Chir., 1914, vol. cxxxi, pp. 189–222.

Kieffsky: F. L. Romanovitch, Resection of Pulmonary Tissue. Warsaw, 1908.

König: Berliner klin. Woch., 1896, p. 132.

Körte: Verhandl. der deutsch. Gesellsch. f. Chir., 40 Kongresz, 1911, vol. i, S. 149.

Krause: Seit 11 Jahren geheilter Fall von Resektion eines Lungenlappens bei Lungenabszess. München med. Wochenschr., 1911, vol. lviii, p. 2418.

Kümmel: Verhandl. der deutsch Gesellsch. f. Chir., 40 Kongresz, 1911, vol. i, S. 147.

Küttner: Druckdifferenz Operationen. Beitr. z. Klin. Chir., 1908, vol. lx, pp. 1–94.

Lejars: Sphacèle du lobe superieur du poumon droit, consecutif à une pneumonie du sommet à formé adynamique; collection suppurée; incision, extraction en bloc du lobe sphacélé; guerison. Bull. et Mem. Soc. de Chir. de Par., 1911, vol. xxxvii, pp. 747–749.

Lenhartz: Verhandl. der deutsch Gesellach. f. Chir., 36 Kongresz, 1911, vol. i, S. 149. *Ibid.*, 1907, vol. i, S. 65.

Lilienthal and Gerster: Treatise on Regional Surgery Edited by Binnie. Vol. iii, Blakiston, 1917.

Lilienthal: Pulmonary Abscess and Bronchiectasis. ANNALS OF SURGERY, June, 1914.

The Therapeutics of Chronic Non-tuberculous Suppurative Bronchiectasis, ANNALS OF SURGERY, July, 1916.

Lowson: Brit. Med. Journ., 1893, vol. i, p. 1152.

Mayer, L.: Les bases physiologique de la chirurgie pleuro-pulmonaires. Brussels, 1906. Ref. in Zentralbl. f. Chir., 1906, Nr. 18, S. 504.

Meyer, W.: Pneumectomy with the Aid of Differential Pressure. An experimental study. Journ. Am. Med. Ass'n., 1919, 532, 1978.

Resection of Lung for Bronchiectasis. ANNALS OF SURGERY, Phila., 1915, vol. xli, pp. 114, 116.

On Bronchiectasis. ANNALS OF SURGERY, Phila., 1914, vol. ix, p. 7.

Miller, W.: Eine Thorax and Lungenresektion mit günstigen Verlauf. Deutsch. Ztschr. f. Chir., 1893, Bd. 37, S. 40.

Demonstration zur Exstirpation ganzen Lungenlappen. Verhandl. der Deutsch. Gesellsch. f. Chir., 40 Kongresz, 1911, vol. i, S. 144.

Mumford and Robinson: Surgical Aspects of Bronchiectasis. ANNALS OF SURGERY, 1914, vol. xl, p. 29.

Murphy: Surgery of the Lung. Chicago, 1898.

Quimby and Morse: Experimental Pneumectomy. Boston M. and S. J., 1911, vols. xl,. clxv, pp. 121–124.

Richerolle, Eugene: Chirurgie du poumon, pneumonotomie, pneumonectomie, Paris, Soc. d'editions scient., 1892.

Riedinger: Verletzungen und Chirurg. Krankheiten des Thorax. Deutsch. Ztschr. f. Chir. Lieferung, 42.

Robinson: Pneumectomy; Its Possibilities. Report of a case of partial lung excision. ANNALS OF SURGERY, Phila., 1912, vol. iv, pp. 512–29.

The Surgery of Bronchiectasis, Including a Report of Five Complete Resections with One Death. Surg., Gyn. and Obst., Chicago, 1917, vol. xxiv, p. 194.

The Resection of the Lobes of the Lung (seven cases; three dead). Journ. Am. Med. Ass'n., 1917, vol. lxix, pp. 355–358.

Rosenthal, G.: Technique moderne de la pneumectomie experimentelle. Bull. Gén. de Therap. Par., 1913, vol. clxvi, pp. 818–828.

Sauerbruch: International Congress Surgeons, Brussels, 1911.

Sauerbruch and Robinson: Investigations Concerning the Technic of Lung Resections with the Application of Different Forms of Differential Pressure. ANNALS OF SURGERY, 1910, vol. l, pp. 320–39. Deutsch. Ztschr. f. Chir. Leipz., 1909, vol. cii, pp. 542–560.

Sauerbruch and Schumacher: Technic der Thoraxchirurgie. Berlin, 1911. Chirurgie der Brustorgane, Berlin, 1920.

Schepelman: Thierexperimente zur Lungenchirurgie. Arch. f. Klin. Chir., Berlin, 1913, vol. c, pp. 985–1017.

Schlesinger, Arthur: Experimentelle Untersuchungen über Lungenoperationen unter interthorakaler insufflation. Verhandl. der deutsch. Gesellsch. f. Chir., 40 Kongresz, 1911, vol. ii, S. 448.

Schmid, Hans: Experimentelle Untersuchungen über partielle Lungenresektion. Berl. Klin. Wochenschr., 1881, Nr. 55, S. 757.

Sonnenburg: Ref. to by Murphy—Lung Surgery, Chicago, 1898.

Stretton, J. Lionel: A Case of Successful Excision of a Portion of Right Lung for Pulmonary Tuberculosis. Lancet, 1906, July 21, vol. ii, p. 161.

Tiegel, Max: Experimentelle Studien über Lungen und Pleura chirurgie Mitt. a. d. Grenzgeb. d. Med. u. Chir., 1907, 3, Suppl., S. 789.

Tuffier: Chirurgie du poumon en particulier dans les cavernes tuberculoses et la gangrene pulmonaire. Par., 1897. Semaine Méd. Paris, 1891, vol. xi, 202.

Veerhoogen: Resection partielle d'un lobe pulmonaire pour Tuberculose. J. de Chir. et Ann. Soc. Belge de Chir., Brux., 1912, vol. xii, pp. 470–473.

Willard, De Forest: Surgery of Tuberculous Cavities of the Lung. J. A. M. A., 1902, September 20.

Experiments in Pneumonectomy and Pneumonotomy. Trans. Coll. Physcicians, Phila., 1891.

Wydler: Zur radikalen Behandlung der Bronchiectasien. Mitt. a. d. Grenzgeb. d. Med. u. Chir., Jena, 1914, vol. xxviii, pp. 141–149.

ABERRANT ADENOID CYSTIC EPITHELIOMAS OF THE SALIVARY GLAND TYPE

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The records of any large surgical clinic reveal, from time to time, a tumor of the head or neck, which when competently studied microscopically is reported as an aberrant adenoid cystic epithelioma of the salivary gland type. But more often an erroneous interpretation results, and the pathologist and the surgeon remain uninformed as to the true nature of the malady. For this reason, the writer has undertaken to report a series of such neoplasms, in the hope that their true recognition may be fostered.

Fig. 1.—The structure presents various shaped cords, columns and groups of rather large epithelial cells, consisting chiefly of nuclei. They present the characteristics of basal epidermal cells. The cords surround many small collections of homogeneous mucinous material which appears to develop from mucous degeneration of the stroma. Some of these collections of mucous are larger, so that definite small cysts appear. The tumor belongs in the group of adenoid cystic epithelioma of salivary gland type.

The subject of mixed tumors situated in the salivary glands, and in the neighboring structures, was, for many years, a hotbed of discussion. Virchow and Cohnheim expounded an epithelial origin. Wartman and Volkman, however, declared the origin to be not epithelial, but endothelial, from lymphatic channels. Krompecher, in Germany, and Ewing,[1] in this country, have written convincingly of the epithelial origin of all mixed tumors of salivary tissue. Their studies have shown the probable origin of contained cartilage, to be from a peculiar epithelial metaplasia.

Any one originating tissue, however, does not meet the requirements of each and every case. Branchial epithelial remnants may well be considered in certain cases. Many such tumors in salivary glands are derived from the ducts and acini. Ewing states that the wide distribution in lips, cheek, orbit and palate indicates strongly that their growth is from misplaced salivary tissue. The close developmental relationship between salivary and buccal epithelium explains why such aberrant rests are so often present in the mouth structures. Ewing quotes Krompecher as concluding that the mixed tumors of the salivary tissue belong in the class of basal-cell carcinoma, and especially in the subgroup of adenoid cystic epithelioma.

A review of the clinical literature indicates the uncertainty that has in the past surrounded this type of growth as found in the hard palate. The oldest reference is the contribution by Rouyer,[2] of Paris, in 1857, in which is recognized an indefinite relationship between such tumors and salivary tissue. Reboul,[3] of Marseilles, in 1892, reports the removal of a small, sessile, non-ulcerated tumor from the hard palate, together with an enlarged lymphatic gland, from the submaxillary space. Histological examination of both specimens showed the presence of irregular epithelial masses undergoing mucous and myxomatous changes. Fragments of cartilage were found. It was recognized as a mixed tumor of the salivary gland type. Defontaine,[4] in 1893, describes a hard palatine

FIG. 2.—The typical appearance of a primary adenoid cystic epithelioma of salivary gland type as found in the tissues of the hard palate.

FIG. 3.—Adenoid cystic epithelioma, salivary gland type, occurring in the upper lip.

cystic growth, as an adeno-epithelioma. Beco,[5] in 1895, refers to the removal of a plum-sized tumor from the hard palate of a woman, twenty-two years old. The tissue was reticulated like a normal parotid gland. Small cysts, filled with colloid material, were present. He called it an adeno-cancer. Berger,[6] in 1897, says that the tumors of the hard palate which seem to be derived from the palatine glands and resemble the mixed tumors of the soft palate, belong to the sarcomata. Chaput,[7] in 1900, excised a small, non-ulcerated, slowly growing tumor from the hard palate of a woman twenty years old. Histologically, it was encapsulated by connective tissue, and composed of irregular epithelial lobules, separated by bands of mucous tissue. He called it a cylindroma. Potherat,[8] in 1903, reports the removal of a lemon-sized tumor from the hard palate of a woman forty-five years old. It had been slowly growing for ten years. The gross appearance was com-

pared to that of a normal parotid. He called it a fibro-adenoma. Workman,[9] in 1903, excised a firm, rounded growth, situated between the mucous membrane and the periosteum of the hard palate. The microscopical report shows it to be of epithelial nature, but no exact diagnosis is ventured. Wood,[10] in 1904, reports four mixed tumors of the palate, and four of the lip. Morestin,[11] in 1905, removed, with great ease, from the hard palate of an adult male, an encapsulated, indolent, non-ulcerated growth which he reports as a mixed tumor of doubtful origin. Such a tumor he says, is very rare in this location. McKenzie,[12] in 1907, writes of an encapsulated endothelial sarcoma, the shape and size of an almond. Marsdon and White,[13] in 1910, reported a patient with a smooth, non-ulcerated, cystic tumor of the hard palate. This was shelled away from the bone without difficulty. Their histological analysis is that of a salivary mixed tumor. Manasse,[14] in 1914, describes a typical endothelioma. In 1919, Finder [15] reports a tumor of the hard palate, half the size of a lemon, and covered with normal mucosa. It had been present for six years, and he calls it a benign epithelioma.

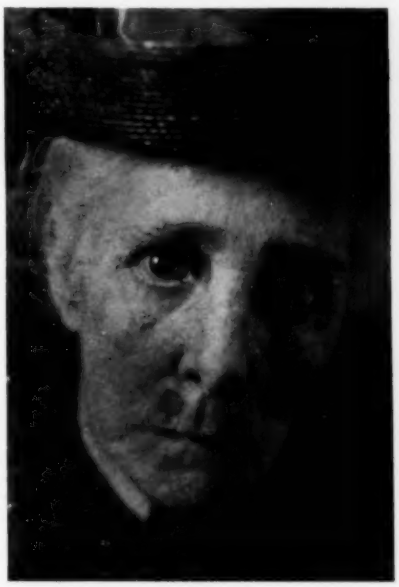

FIG. 4.—Case No. IV, clinically free of disease.

From this résumé of the literature it is quite apparent that the same type of palatine tumor has received various interpretations. This is quite comprehensible, when it is considered how profoundly metaplasia may alter the histological characters. The more complete reports all agree that the lesion is of slow growth, non-ulcerating and is of cystic character. No bone invasion is reported, but pressure atrophy of the palatine process is mentioned.

The Memorial Hospital records reveal five tumors occurring in the tissues of the hard palate, one in the upper lip, and one deep to the skin of the forehead, which were reported by Ewing, as adenoid cystic epitheliomas of salivary gland type.

Case II of the table received this typical pathological report. "Three stained sections show a basal-cell carcinoma of the salivary gland type, but there is no tendency to formation of cartilage. The cells are small, composed mostly of very hyperchromatic nuclei. The stroma tends to mucinous degeneration. Two of the sections show more active growth of the larger cells in alveolar arrangement."

The following tabulated report is compiled from the case records:

TABLE I

Case	Age	Sex	Total duration of lesion	Primary or recurrent	Gross characters	Treatment	Results	Initial diagnosis
1	29	F.	3 years	Recurrent on the hard palate 3 months after operation	Size 3:2.5:1.5, centimeters. Area of ulceration 1 centimeter in diameter, cystic	Buried emanation 6 millicuries	Clinically free of disease 1 year	Adenoid cystic epithelioma of salivary gland type
2	32	M.	2½ years	Recurrent on hard palate after 2 operations	Size 3:3:3 centimeters; no ulceration	Buried emanation 8.2 millicuries	Clinically free of disease for 1 year	Sarcoma
3	33	F.	1 year	Primary on hard palate	Size 3:3:1 centimeters. No ulceration, appeared as a smooth, globular tumor with elastic consistence	Buried emanation 8 millicuries	Clinically free of disease for 8 months	Sarcoma
4	57	M.	4 months	Primary on the hard palate; incised once as an abscess	Size 2:2:1 centimeters. No ulceration; appeared as a smooth, elevated tumor	Buried emanation 8 millicuries	Clinically free of disease for 10 months	Adeno-sarcoma
5	51	M.	3 years	Recurrent on the hard palate 5 months after operation	Size 2: 1: 0.5 centimeters. Ulcerated, granular tissue in a hollowed out palate	420 milligram hours of radium emanation filtered by ½ millimeter of silver	Clinically free of disease for 10 months	Glandular sarcoma
6	62	F.	7 years	Primary on the upper lip	Size; 4:3:2 centimeters. Pedunculated, non-ulcerated elastic consistence	Buried emanation 5.6 millicuries	Clinically free of disease for 1½ years	None given
7	43	M.	2 years	Prophylactic treatment of scar on forehead	No evidence of disease	594 millicuries hours of emanation, 1 centimeter distance, filtration ½ millimeter of silver and 2 millimeters of brass		Sarcoma, very malignant

An analysis of these records shows that two palatine lesions were observed in their primary state, and three were altered by one or more local operations. The gross character of the two unoperated lesions was identical, and corresponds very closely to the descriptions given in the clinical references. In Cases II and III; each patient presented a recurrent lesion after a very incom-

plete surgical procedure. The appearance was, however, so suggestive that a clinical diagnosis of adenoid cystic epithelioma of the salivary gland type was ventured, and was confirmed microscopically. It here may be stated that a primary lesion appears as a mound-like growth, springing from the hard palate close to the alveolar process. The overlying mucosa is intact. Ulceration would probably occur, following surgical misusage, or long neglect. The tumor is adherent deeply, and conveys to the palpating finger an impression of elastic firmness. Radiographic examination demonstrates no bone changes. No symptoms are produced, other than mechanical annoyance. Metastatic deposits are not present, and in no case did they occur subsequently.

Cases I, II, III and IV were treated locally by imbedding radium emanation tubes in the substance of the tumor. In Case V the recurrence was not bulky, so emanation tubes, filtered by one-half millimetre of silver, were applied by means of dental modelling compound. Only one treatment was found to be necessary to cause a complete primary regression of the disease.

Case VI is that of a patient presenting a very large, non-infiltrating and non-ulcerating growth of the skin surface of the upper lip. The actual pedicle of attachment was not more than one centimetre in diameter. Radium emanation tubes, buried in its base, caused a disappearance of the growth, and a restoration of the affected part, in a period of three months.

Case VII is that of an adult male referred for prophylactic radium treatment after two excisions of the growth, which was situated on the forehead adjacent to the right eyebrow. The tumor rested on the periosteum and was considered to be a very malignant sarcoma.

It is very significant that in only one patient was the palatine lesion recognized, clinically or histologically, before being referred for radium treatment. Sarcoma was the popular diagnosis, although in one instance this was varied to adeno-sarcoma. Case III was observed first at one of our leading hospitals. Here a small section was removed and pronounced by the pathologist to be sarcoma. The surgeon accepted the diagnosis without question, and considered that radium treatment held out more hope than an operation. Either procedure, if properly executed, would undoubtedly eradicate the disease.

CONCLUSIONS

1. Adenoid cystic epitheliomas of the salivary gland type, occurring in the tissues of the mouth and face, are not as uncommon as the literature would indicate. Such neoplasms have been reported, but not properly recognized, and histologically interpreted.

2. The tendency is to regard them as sarcomas. To this fact may be attributed some startling surgical cures.

3. The characteristic tumor has slight malignant properties. Therefore it does not ulcerate and invade in its early stage.

4. Radium treatment has been entirely successful in these cases.

BIBLIOGRAPHY

[1] Ewing: Neoplastic Diseases, chap. xxxvi.
[2] Rouyer: Monit. de hôp. Paris, 1857, vols. i, ix, xx, xxvii.
[3] Reboul: Marseille Méd., 1892, vol. xxix, pp. 62–69.
[4] Defontaine: Arch. Provinciales Chir., April, 1893, vol. ii, pp. 249–254.
[5] Béco: Rev. de Laryng. Otol. et Rhin., 1895, vol. xv, pp. 708–709.
[6] Berger: Rev. de Chir., 1897, vol. xvii, pp. 361–399, 470–481, 551–572.
[7] Chaput: Soc. Anat. Paris, 1900, vol. lxxv, pp. 906–908.
[8] Potherat: Soc. Chir. Paris, 1903, vol. xxix, 1151–1152.
[9] Workman: Glasgow Med. Jour., 1903, vol. lix, pp. 287–288.
[10] Wood: Annals of Surgery, 1904, vol. xxxix, pp. 57–97, 207–239.
[11] Morestin: Soc. Anat. Paris, 1905, vol. lxxx, pp. 918–919.
[12] McKenzie: Roy. Soc. Med. Laryng. Sect., 1907–1908., vol. ii, p. 62.
[13] Marsdon and White: Med. Chron., April, 1910, vol. lii, pp. 1–6.
[14] Manasse: Internat. Centralbl. Laryngol. and Rhinol., 1914, vol. xxx, p. 328.
[15] Finder: Internat. Centralbl, 1919, vol. xxv, pp. 19–20.

DIAPHRAGMATIC HERNIA*

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During the past few years interest in hernia through the diaphragm has received marked stimulus for two definite reasons. First, hernia through wounds of the diaphragm have been observed during the Great War in a comparatively large number of cases because of the penetrating and explosive force of high-powered modern missiles. Second, the X-ray with its greater range of efficiency has demonstrated this pathologic condition heretofore mostly determined only at operation or autopsy.

Frequency of Occurrence.—Up to the beginning of the Great War 650 cases of diaphragmatic hernia had been reported in the literature by Griffin. Of these 650 cases but fifteen had been diagnosed before operation or autopsy. Since the onset of the Great War there have been an increasing number of case reports of this condition. Within the past year Bevan has reported four cases. Portis, Mathews, Howk, Belden, Gresive, Cotte, Quentin, Hartung, Huffman, Nieden, Reichel, and Schlecht have each reported a case. Macmillan reports three cases of diaphragmatic hernia among 15,000 X-ray examinations made at General Hospital Number 1. Of these three cases two were traumatic hernias following shrapnel wounds. The third case was thought to be incident to an operation for empyema. A recent communication from the Mayo Clinic states that no cases of diaphragmatic hernia have been observed in their hospital since those reported by the late Doctor Beckman in 1916. At that time Beckman reported three cases, one seen in 1909, one in 1911 and one in 1916.

Etiology.—Anatomically, the diaphragm presents points of weakness which are consequently the most frequent sites of rupture. Most commonly the œsophageal opening presents hernial possibilities. The junction between the ensiform process and the costal cartilages is devoid of muscular tissue, as is the space posteriorly between the psoas muscles and the ribs; therefore, these regions ofttimes mark points of entrance of hernias into the thoracic cavity.

Congenital defects in one or both domes of the diaphragm may occur. The usual pathologic lesion seen, however, is an abscess of muscular tissue around the œsophageal foramen. This congenital opening may be large or small and will be limited latterly by the pillars of the diaphragm.

The exciting cause of acquired diaphragmatic hernia falls under two heads; namely, increased intra-abdominal pressure and direct injury. Increased intra-abdominal pressure sufficient to produce rupture of the diaphragm is seen in crushing accidents, long and difficult labors, persistent strain-

* Read before the District of Columbia Medical Society, May 25, 1921.

ing at stool, etc. Direct trauma to the diaphragm is necessarily secondary to penetration of the chest or abdominal wall. Thus the projectile, dagger, bayonet and knife are the most common instruments of danger.

Contents of Diaphragmatic Hernia.—A rupture of the diaphragm having occurred either from congenital or acquired causes, there exists a direct communication between the abdominal and thoracic cavities. Because of the negative pressure in the chest during inspiration and positive pressure in the abdomen the hernia always passes through the hernial opening from the abdomen into the thorax. A hernial sack may or may not be formed. In fact, a true sack in the sense of a peritoneal pouch is seldom seen.

In 1897 Lichtenstern analyzed 250 cases of diaphragmatic hernia and pointed out that the stomach was the abdominal organ most frequently found in the thorax. Other abdominal viscera in order of their herniated frequency are transverse colon, omentum, small intestine, spleen, liver, pancreas, and lastly kidney.

Symptomatology.—Generally speaking no definite symptom complex can be given for diaphragmatic hernia. In either the acquired or congenital types of hernia the symptoms must depend very largely upon the size of the diaphragmatic opening, the degree of constriction and the organs involved. As a rule the symptoms are not commensurate with the anatomical defect. In the acquired type of diaphragmatic hernia, the symptoms are apt to be acute in accordance with the etiological factor entering into the cause of the rupture. In the congenital form of hernia the symptoms are generally chronic in character, accentuated at times by functional disturbances.

Summing up, we may expect symptoms that would follow a mechanical displacement of abdominal viscera from their normal abode to an adjacent cavity. Combined with the visceral displacement must be borne in mind the not infrequent occurrence of complications such as adhesions, constrictions, inflammation, obstruction, etc., of the hernia.

In face of such varying possibilities as to cause anatomical derangement and complications it can be readily understood that diaphragmatic hernia has no pathognomonic symptoms. Griffin has said that three subjective symptoms are present in a good percentage of cases. These are first, pain in the epigastrium and chest immediately after eating; second, paroxysms of smothering without apparent cause; and third, vomiting without premonition.

More accurate conclusions can be drawn from the objective signs. Thus the presence of abdominal viscera in the thorax may sometimes be determined by careful physical examination. X-ray examination is of the greatest value and exploratory operation is, of course, determinative.

Pneumothorax, subphrenic abscess and diverticulum of the œsophagus must be considered in the differential diagnosis. In case of doubt the X-ray can be depended upon to clear the question.

Treatment.—Surgery is the only curative treatment for hernia of the diaphragm. In operating two sites of approach may be considered; the thoracic and the abdominal, or, a combination of both. Unquestionably the

abdominal route is the one of choice. When adhesions prevent the reduction of the hernia from below, a thoracotomy, though adding to the operative risk, may be necessary to enable the operator to free the hernia from above and restore its contents to the abdominal cavity. When a traumatic opening

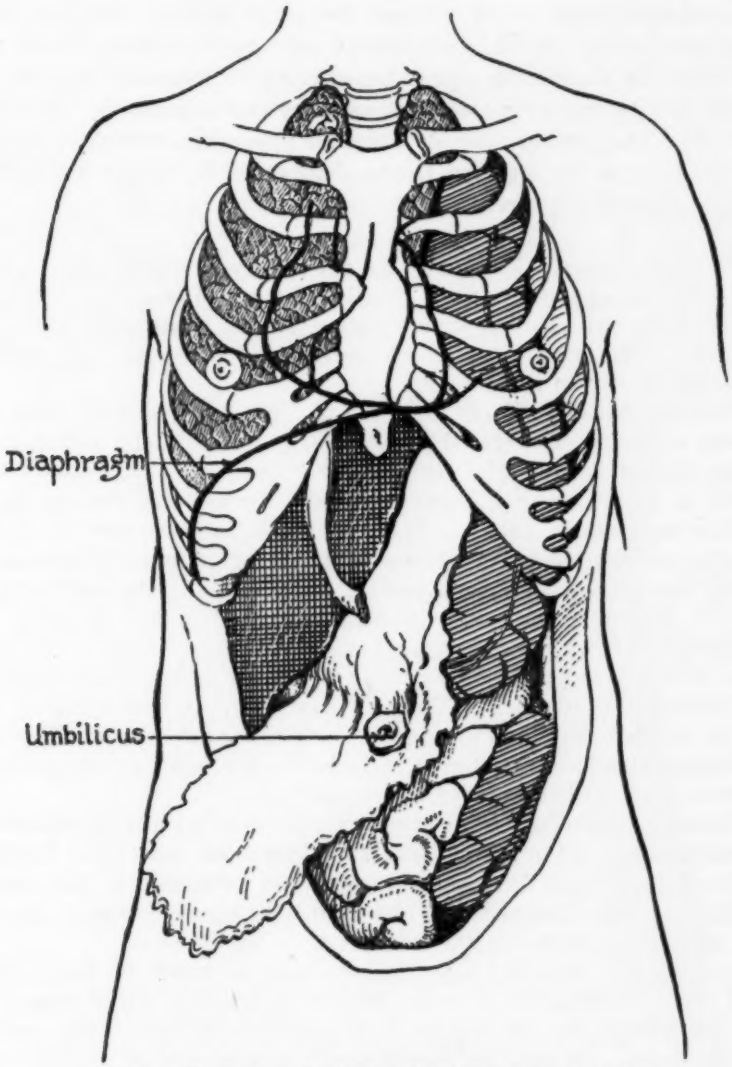

FIG. 2.—Heart shown displaced to right by contents of hernia.

exists in the chest as in some shell wounds or other cases the hernia may be repaired through it from above.

When operating from below a long left rectus or the S incision of Bevan is recommended for good exposure. With the abdomen open the technic of reduction and repair must depend upon conditions as found. Usually a

diaphragmatic hernia is reduced without difficulty; but, on the other hand, it may be necessary to incise a constricting ring or break up adhesions before accomplishing the desired result.

Repair of the hernial opening in the diaphragm is effected by bringing together the pillars of the opening. This is usually accomplished by placing interrupted sutures of catgut. Where the diaphragm is sufficiently lax, the edges of the opening should be overlapped and sutured to better insure permanent repair. In those cases where the opening is favorably situated it may be closed by suturing to the chest wall as in the case reported by Mitchell. If the opening is too large to close by suture the stomach, mesentery and possibly the omentum may be attached to the diaphragm in such a manner as to effectually close the rupture.

AUTHOR'S CASE.—Miss I. W. K., age twenty-five, nationality American, occupation trained nurse. Family History: Mother died of gastric cancer at the age of thirty-nine. Father died of pneumonia at the age of forty. One brother, age twenty-seven, and one sister, age twenty-three, living and in good health.

Previous History: Birth was normal. Her grandmother, who was present at her birth, states that patient was a small baby and that her mother had an easy labor. At the age of seven years she had a severe attack of whooping-cough that lasted for six months, threatening at one time to terminate fatally. During her childhood her parents always referred to her as being a delicate child. Indigestion and shortness of breath was always a constant complaint. At school she had no difficulty in mastering her work, graduating at high school in 1914. In the last year of her school she had her first so-called "spell." She was taken with severe and sudden pain in the lower abdomen accompanied with nausea and vomiting. The pain was radiating, first being on one side of the abdomen and then shifting over to the other side. This and subsequent attacks forced her to bed where she would remain for three to seven days until she gradually became better.

These attacks would recur at varying intervals of a week, month or several months. They would be ushered in without warning. Nothing in the character of these attacks drew her attention to the thorax for the pain was always in the abdomen. At times, however, she did have sensations of gas in the left chest.

In 1915 she entered a local hospital and assumed the duties of a pupil nurse, graduating in 1918. While in training she continued to have her attacks, but she was never sick enough to require the services of a physician. In 1917 her tonsils were removed, and in 1918 she was confined to bed for two days with what was then diagnosed pleurisy of the left chest.

Present Illness: At 4 A.M., April 28, 1920, patient was seized with a sudden and severe pain in the lower abdomen, which was typical of her usual attacks. This was accompanied with nausea and vomiting. On the following day, as her condition did not improve, surgical advice was requested. Physical examination at this time revealed the following:

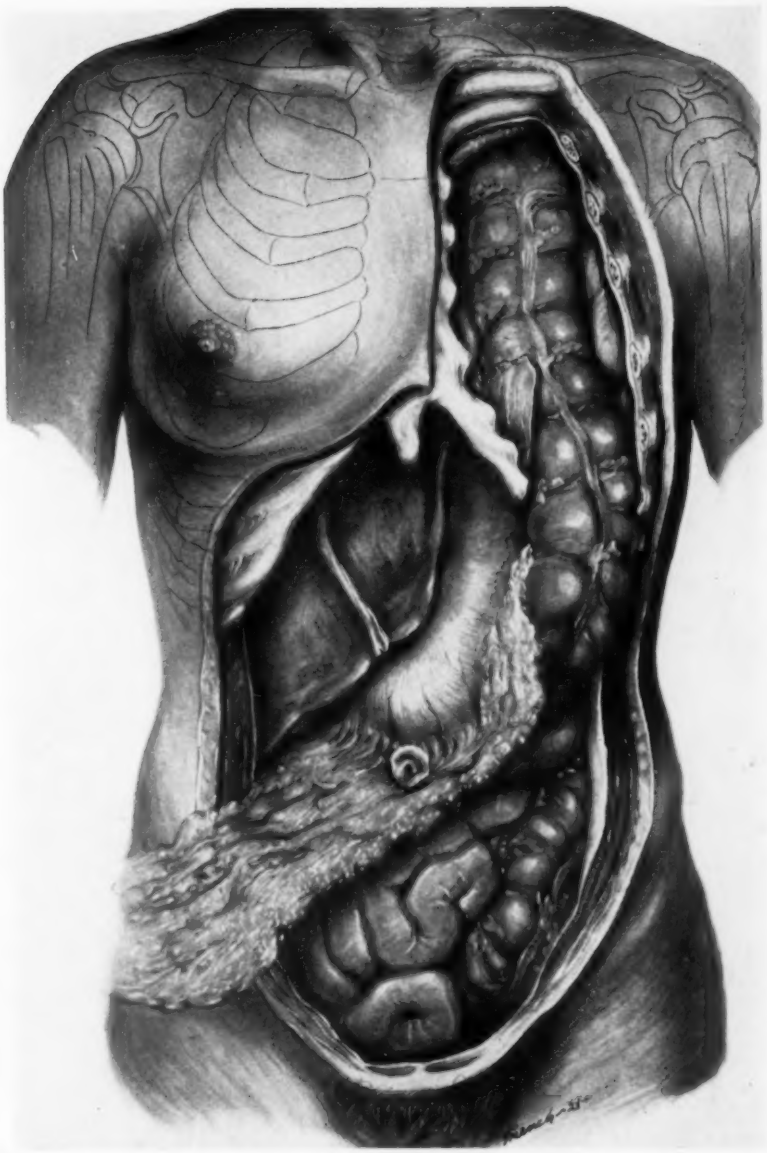

FIG. 1.—Diaphragmatic hernia before operation. Large opening in diaphragm and ptosis of stomach and liver may be noted. Insert showing displacement of heart to the right.

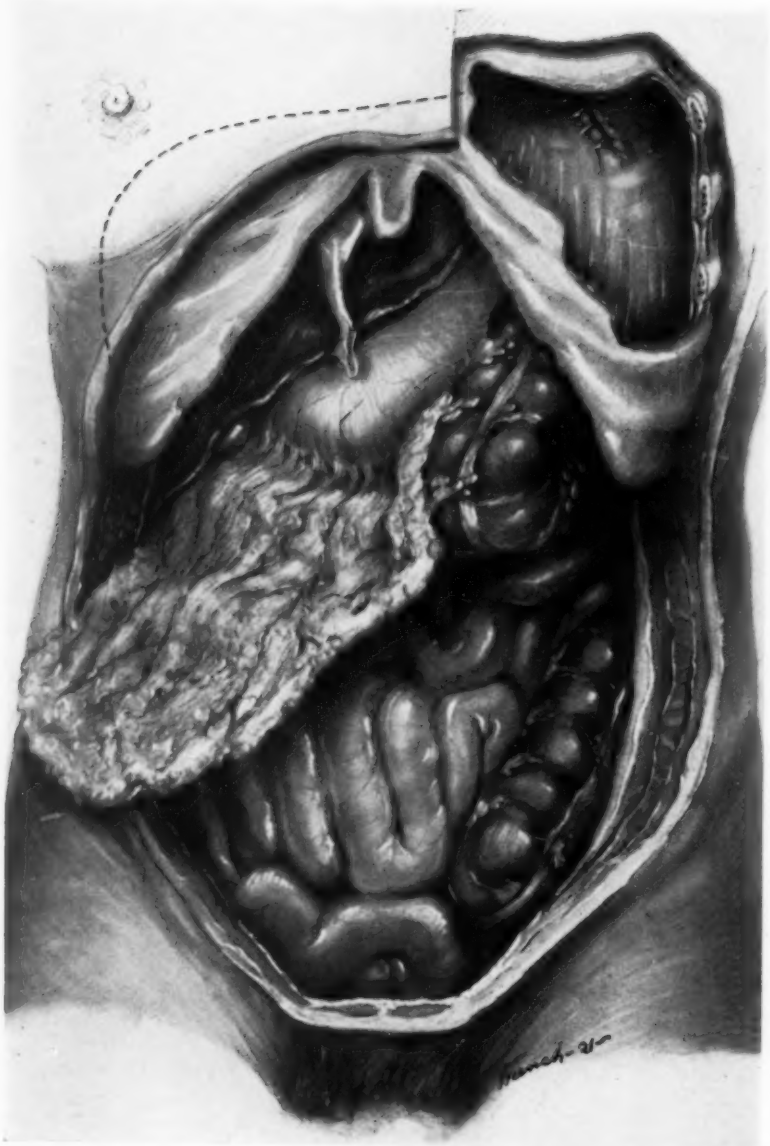

FIG. 3.—Diaphragmatic hernia after repair. Pillars of hernial opening sutured with interrupted chromic catgut.

FIG. 5.—X-ray demonstrating the presence of the large intestine in the left thoracic cavity. The lung is collapsed and crowded up under the clavicle.

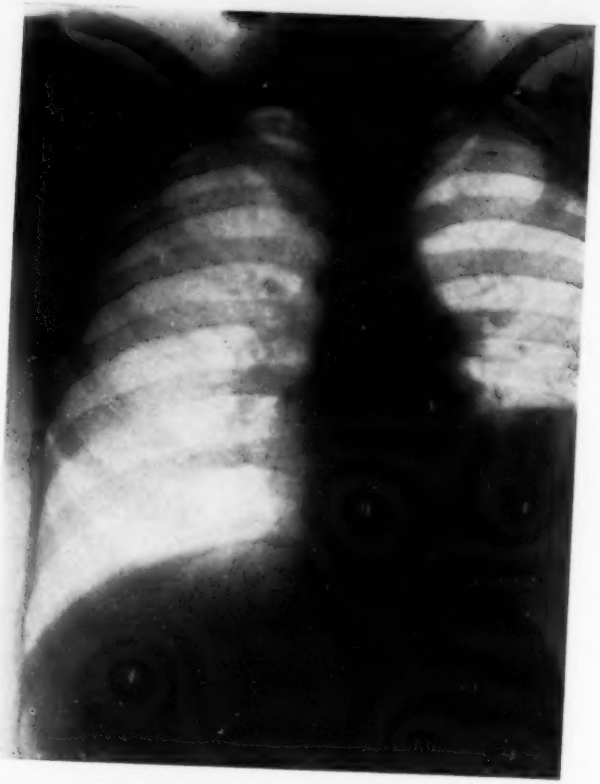

FIG. 6.—X-ray showing expanded lung filling left thoracic cavity. Picture taken three months after operation.

Temperature, 99°; pulse, 76; respirations, 20. Abdomen generally tender, but marked tenderness and rigidity definitely localized over McBurney's point. Leucocyte count of 16,000. With a seemingly definite history of former attacks and in the presence of positive physical

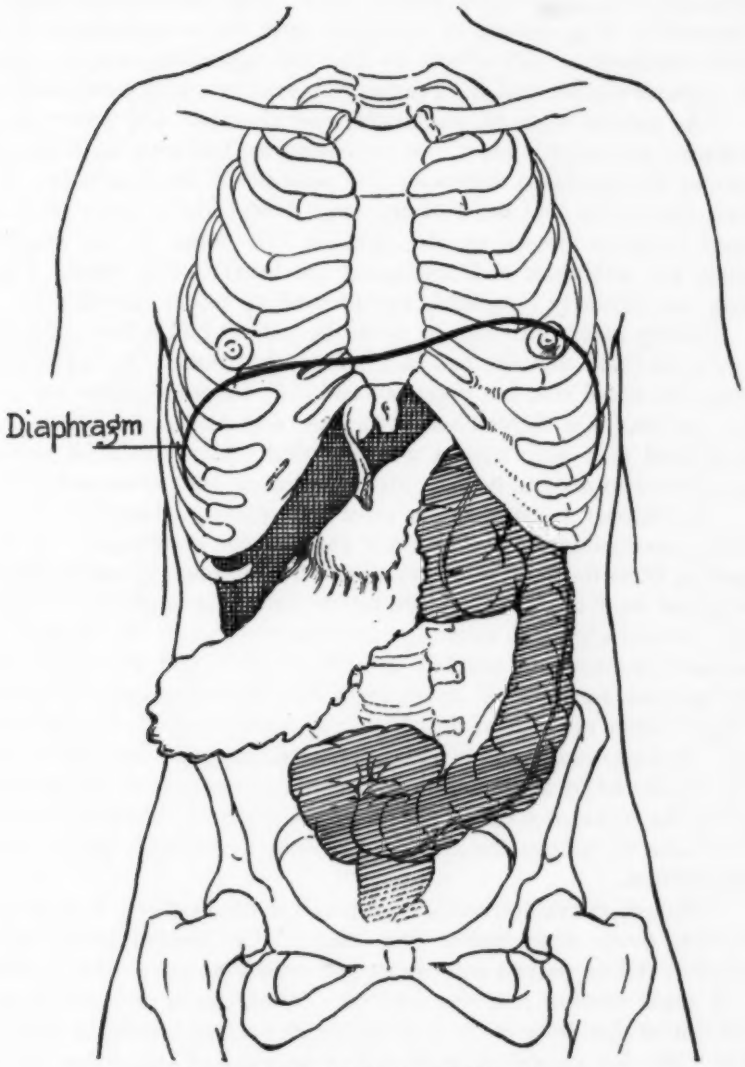

FIG. 4.—Relative height of repaired diaphragm.

and clinical findings, a diagnosis of acute appendicitis was made. Operation was accordingly advised.

Routine examination of the chest, made prior to operation, was recorded on the chart as follows: "Heart and lungs normal. Heart sounds somewhat indistinct."

A muscle-splitting opening showed the presence of a large amount of peritoneal fluid. Exploration demonstrated a ptosis of both the liver and the stomach. The lower edge of the right lobe of the liver was directly over the McBurney incision. An area, three inches in diameter, on the anterior surface of the liver, was whitish and studded with what appeared to be tubercular nodules. This, with the presence of an abnormally large amount of peritoneal fluid, led to a diagnosis of tubercular peritonitis. All efforts to find the appendix, cæcum, ascending or transverse colon failed. Further exploration was deemed inadvisable.

The patient made an uneventful convalescence and returned to her work in one month's time. In the meantime, however, an X-ray examination was made to determine the position of the appendix. It was then discovered that most of the large bowel and a large part of the small intestine passed up through the left dome of the diaphragm, filling the left chest and displacing the heart to the right. The left lung was almostly completely compressed up under the clavicle.

Shortly after returning to work the patient had a few mild attacks similar to those that she had had before operation. On September 26, 1920, she noted that her abdomen suddenly became smaller by at least two inches. On September 27th, one day later, she began having abdominal pain with nausea and vomiting. Her condition persisting, operation appeared to be the only logical hope for permanent relief.

On October 1, 1920, under ether anæsthesia, a long left rectus incision was made, exposing the left dome of the diaphragm. A hernial opening three inches in diameter was observed through which passed the large and small intestine. At the lateral and outer border of the opening well-formed adhesions were separated and the thorax was emptied of its herniated contents by manual reduction. The right hand and arm of the operator were passed up through the diaphragm and the intestines dragged down and out of the chest. The pillars of the hernial opening were then sutured together with interrupted catgut. The line of suture was reinforced by attaching the base of the mesentary of the small intestine to the repaired area. Because of the patient's condition no attempt was made to remove the appendix or attach the large gut in its normal position.

Although convalescence was stormy for the first few days, the temperature never went higher than 99.6°. The wound healed by first intention and the patient was discharged twenty-two days after operation.

A three months' rest was advised. Work has been resumed and to date patient has been in the best of health with no return of abdominal pain. She has gained eight pounds in weight and states that she feels perfectly well.

Dr. A. C. Christie renders the following report three months after operation: " Examination of the colon on this date after administration of barium enema shows the colon to be entirely in the abdominal cavity. The left dome of the diaphragm is much higher than usual. The cæcum appears to be in the upper left quadrant of the abdomen. The left

lung appears to have expanded so that it fills the chest." Physical examination of the chest by Dr. B. M. Randolph confirms the X-ray findings relative to the left lung.

Because of its unusual pathology and undetermined etiology this case is of interest. The etiology rests between a possible congenital diaphragmatic defect or an acquired rupture as a complication of severe pertussis.

HEPATICODUODENOSTOMY FOR INJURY OF THE BILE DUCTS DURING CHOLECYSTECTOMY

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It is the general experience that injury of the common and hepatic ducts is usually the result of operative accidents. Since the operation of cholecystectomy has come, in a great measure, to supplant that of cholecystostomy, there has been a corresponding increase in the number of patients presenting themselves suffering from injuries to the bile passages. In only a small percentage of these cases will the accident be recognized at operation: the great majority presenting themselves some weeks or months later on account of a permanent biliary fistula, jaundice, or some other symptom of obstruction. It is a noteworthy fact that these surgical disasters are by no means limited to cases operated on by the novice, accidents of this nature having been reported by such men as Mayo,[1] Doyen,[2] Moynihan,[3] Kehr,[4] and others. Out of six cases of operative injury to the bile ducts during cholecystectomy that have recently come under my observation, the operations at which the accidents occurred had been performed by men of large experience in all cases but one. I still have a vivid recollection of assisting a surgeon of good repute and wide experience to do a cholecystectomy when about three-quarters of an inch of the hepatico-common duct was excised. Traction on the cystic duct had resulted in the clamp being placed on the drawn-up, angulated portion of the hepatico-common duct instead of the cystic duct. Fortunately the accident was noticed at the time and the defect repaired over a "T" tube with a good functional result.

These injuries to the bile ducts are mainly due to the failure of the operator to identify the cystic duct, and this is primarily the result of a poor exposure of the operative field. If an ample incision, preferably of the Bevan[5] type, is made, the right lobe of the liver dislocated downwards and brought out through the wound, and the duodenum drawn gently to the left by an assistant, a good exposure will usually be obtained. In a few cases it may be necessary to place a gauze compress between the superior right lobe of the liver and the chest wall, as recommended by Masson,[6] to bring the field into view. Then if the dissection is begun from below, while the field is still free from blood, there is little excuse for injuring the ducts. In some instances the injury may be due to hemorrhage from the cystic artery, the operator grabbing blindly into the space where the vessel has retracted, with heavy cutting forceps. Anatomical variations in the ducts and vessels, as reviewed by Eisendrath,[7,8] and Gosset,[9,10] may also be mentioned as a contributory cause of damage to the bile ducts, though the danger from these

anomalies would be inconsiderable if a proper exposure was obtained and the ducts identified.

While the removal of a gall-bladder is usually a simple surgical operation, reconstruction of the bile passages, perhaps weeks or months after the injury has occurred, is a formidable procedure. Moreover, the surgeon may succeed in establishing a passage-way for the bile from liver to intestine, only to find that obstruction recurs from cicatricial contraction in a few weeks or months.

Three clinical types of cases, the result of operative injury during cholecystectomy are met with:

(1) The case of biliary fistula with clay-colored stool, the condition being continuously present since operation.

(2) The case in which the patient becomes deeply jaundiced immediately following the operation, with little or no discharge of bile in the stools or on the dressings. Later a biliary fistula usually develops.

(3) Cases which do quite well after the operation, excepting that the discharge of bile through the drainage keeps up longer than usual. All goes well until some weeks or months after the fistula closes, when the patient develops jaundice, slight at first and intermittent, later tending to become deeper and more permanent. There is general skin pruritus with perhaps fever of low degree during exacerbations.

Regarding the nature of the injury, there may be stricture due to crushing or ligation, or the duct may have been divided or a portion of it resected. The stricture or defect is usually from one to two centimetres in length and is located at or near the point of entrance of the cystic duct.

The subject of operative injuries to the bile passages and methods for their repair has been well presented in very excellent articles by Mayo,[11] Jacobson,[12] Sullivan,[13] Walton,[14] Elliot,[15] and others.

The type of operation employed in each particular case will depend on the extent and location of the injury, and in some cases on the condition of the patient. If one is successful in locating the duct above and below the obstruction and sufficient tube is available to bridge the defect, the operation of choice is an end-to-end anastomosis over a rubber tube, reinforcing the union with omentum. Where the lower segment of the duct is utilized the normal papillary entrance into the duodenum is preserved, and the danger of regurgitation of intestinal contents into the bile ducts and ascending infection of the bile tract and liver is avoided.

When the length of the damaged area is so great as to preclude the possibility of bringing the two ends of the duct in contact, the defect may be bridged with omentum over a rubber tube as worked out experimentally by Sullivan.[16] This method has the disadvantage that it does not insure a mucous-lined tube and tends to become stenosed.[17]

While the presence of bile in the proximal end of the injured duct usually makes its identification easy, great difficulty will frequently be experienced in locating the distal portion. In some of these cases the physical condition of the patient will not allow of a prolonged search, and it will be considered good

surgical judgment to implant the stump of the hepatic duct direct into the duodenum. Hepaticoduodenostomy, as performed in the case here reported, carries with it the possibility of regurgitation of bile into the bile ducts and ascending infection of the bile passages and liver. The common hepatic duct from its origin from the right and left hepatic ducts in the transverse fissure of the liver, to the point where it is joined by the cystic duct, measures two and a half centimetres in length.[18] In performing the operation of hepaticoduodenostomy the operator seldom has more than one and one-half centimetres of duct above the obstruction for purposes of anastomosis. With a stump of hepatic duct little greater than a centimetre in length, the "physiological" implantation of Coffey[19] is impractical, and to attempt to carry out the principle by passing a rubber tube obliquely through the duodenal wall (Witzel) is of doubtful value. All methods of valve construction at the entrance of the bile duct into the intestine lack the normal sphincter control, and I have been unable to find any evidence in the literature that would indicate that the results obtained in cases where methods of this type were used, were better than where a direct implantation was made without any attempt at valve formation. That an individual can remain in perfect health indefinitely after a direct implantation of the hepatic duct into the duodenum, is shown by the case of Mayo,[20] the patient remaining well after fifteen years.

Duodenal fistula, with peritonitis from leakage of intestinal contents, or death from starvation is a grave complication that may follow hepaticoduodenostomy. This serious complication occurred in my case, though fortunately the patient recovered.

In some cases on account of the serious condition of the patient, it will be considered advisable to do the operation in two stages. At the preliminary operation the duct above the obstruction is drained, and when jaundice has disappeared and the patient has sufficiently improved, the second operation to reëstablish the flow of bile from liver to intestine may be undertaken.

AUTHOR'S CASE.—Miss B., aged twenty-three years, had her gall-bladder removed at another hospital in January, 1918. For five months following the operation she had a biliary fistula and clay-colored stools. One year after the fistula closed she began to have increasing discomfort in the right upper quadrant, some general pruritus, and noticed that her skin and conjunctiva had at times an icteric tint. This condition gradually increased in severity, and in August, 1920, her stools were clay-colored for four days. Three months later she had a similar attack lasting a week, and these attacks at varying intervals have recurred to date. The pain in the upper abdomen has also increased in severity. The itching of the skin is now continuous and intolerable. She has not worked since her gall-bladder was removed.

Operation, March 11, 1921. The old operative scar was excised. The liver and omentum were found densely adherent to the anterior abdominal wall. The liver, transverse colon, omentum, stomach, duodenum and bile ducts were a dense tangle of adhesions. Landmarks

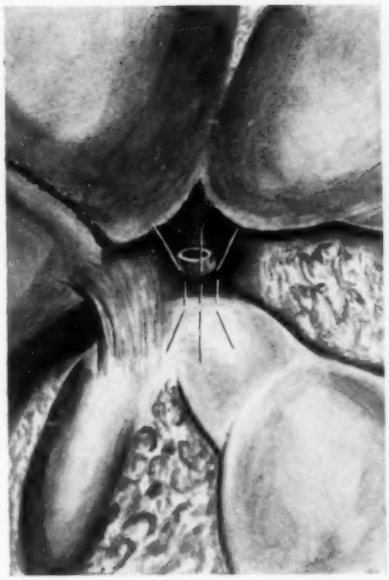

FIG. 1.—Stump of hepatic duct dissected free from adhesions. Stay sutures placed in position. Notice the absence of the gall-bladder.

FIG. 2.—Stay sutures tied. Stab made in duodenum and posterior row of stay sutures placed and tied.

FIG. 3.—Rubber tube shown with lower end in duodenum and upper end fixed in hepatic duct with suture of chromic catgut. Through and through sutures continued anteriorly.

FIG. 4.—Anastomosis completed. The insert shows the method of placing the lateral sutures to bring up an anterior and posterior fold, thus bringing a broad peritoneal coated surface of intestine in contact with the lower end of the duct and forming at the same time a papillary entrance for the duct into the duodenum.

were obliterated; the foramen of Winslow closed. The dissection was carried down carefully along the under surface of the liver. In doing so the liver capsule was lacerated, causing troublesome bleeding. The hepatic duct was identified and explored. Its distal end was lost in a mass of dense scar tissue. The stricture was impervious to the finest probe. Efforts to identify the duct below the stricture were unsuccessful and it was thought better to implant the hepatic duct direct into the duodenum than to endanger the life of the patient by a prolonged search which might ultimately end in failure. An hepaticoduodenostomy was then performed as follows: The stump of the hepatic duct was freed from its surroundings for one-quarter of an inch. Owing to the position in which the duodenum was adherent, it was possible to bring the end of the duct in contact with it, at a point suitable for anastomosis, without disturbing its posterior adhesions. The duodenum, at a point about two inches beyond the pylorus, was caught with three stay sutures, plain catgut, and fastened to the scar tissue posterior to the hepatic duct (Fig. 1). A stab was made through all the coats of the intestine, and a row of interrupted sutures of No. 00 chromic catgut were passed from the mucous surfaces through all the coats of both duct and intestine, uniting about one-half the circumference of the duct with the opening in the duodenal wall (Fig. 2). A rubber tube large enough to fit loosely in the hepatic duct was passed through the opening in the duodenum, and its upper end fastened in the end of the duct with a suture of chromic gut. The tube projected into the duodenum for a distance of three inches and was perforated with a terminal and a lateral eye. The row of sutures were then continued anteriorly, uniting the remaining half of the duct with the duodenal opening (Fig. 3).

The duodenum on each side of the anastomosis was then caught with three interrupted catgut sutures as shown in insert Fig. 4. These sutures when tied formed an anterior and posterior fold, bringing a broad surface of peritoneal-covered intestine in contact with the lower end of the duct, and also forming a papillary entrance for the duct into the duodenum. A rubber tissue drain placed down to the site of the anastomosis was brought out through the upper angle of the wound, and the abdomen closed.

The patient reacted well, and progressed favorably without leakage for four days. Then suddenly, for some unknown reason, she became violent, getting out of bed and behaving generally in an insane manner. Two attendants were required to restrain her. The following day there was a discharge of bile on the dressings, and on the second day after her escapade the dressings were soiled with duodenal contents also. The opening in the duodenum rapidly enlarged and in a few days practically everything taken by mouth passed out the fistulous opening. She was put on saline and nutrient enemata per rectum and given nothing by mouth. She lost flesh in a most alarming manner. However, the duodenal fistula closed spontaneously in three weeks. A week later bile appeared in the stool and a few days afterwards the biliary fistula

closed. She gained rapidly in weight and strength and was discharged from the hospital on May 5th.

At the present time (eight months after the operation) she is back at her work, feeling well. She has had no return of jaundice or pruritis. The wound is well healed and the scar healthy. Though instructions were given to have all stools examined, the rubber tube used in making the anastomosis was not found. X-ray examination, however, three months after the operation, showed it to have passed from the gastro-intestinal tract.

REFERENCES

[1] Mayo, W. J.: Some Remarks on Cases Involving Operative Loss of Continuity of the Common Bile Duct, with a Report of a Case of Anastomosis Between the Hepatic Duct and Duodenum. ANNALS OF SURGERY, vol. xlii, p. 90, July, 1905.

[2] Moynihan: Abdominal Operations. Second edition, 1906, p. 688.

[3] Moynihan: Tr. Leeds and West Riding Medico-chirurgical Society, Cholecystectomy. Lancet, vol. ii, p. 1702, Dec. 10, 1910.

[4] Kehr, Prof. Hans: Die praxis der Gallenwege-Chirurgie in Wort und Bild., vols. i and ii, 1913.

[5] Bevan, Arthur Dean: On the Surgical Anatomy of the Bile Ducts, and a New Incision for Their Exposure. ANNALS OF SURGERY, vol. xxx, p. 17, 1899.

[6] Masson, J. C.: Exposure in Gall-bladder Surgery. ANNALS OF SURGERY, vol. lxix, pp. 423–425, 1919.

[7] Eisendrath, D. N.: Anomalies of the Bile-ducts and Blood-vessels as the Cause of Accidents in Biliary Surgery. Jour. Am. Med. Assn., vol. lxxi, pp. 864–866, 1918.

[8] Eisendrath, D. N.: Operative Injury of the Common and Hepatic Bile-ducts. Surg., Gynec. and Obst., vol. xxxi, pp. 1–18, 1920.

[9] Gosset, A.: Travaux scientifiques. Paris, Masson, 1919, p. 156.

[10] Gosset, A., and Demarest, E.: Les artères de la vesicule et la cholecystectomie. Bull. et mém. Soc. mém. d. hôp. de Par., vol. xxxvii, pp. 15–30, 1911.

[11] Mayo, W. J.: Restoration of the Bile-passages After Serious Injury to the Common or Hepatic Ducts. Surg., Gynec. and Obst., vol. xxii, pp. 1–6, 1916.

[12] Jacobson, J. H.: Repair and Reconstruction of the Bile-ducts. Am. Jour. Obst., vol. lxx, pp. 948–965, Dec., 1914.

[13] Sullivan, A. G.: Reconstruction of the Bile-ducts. Jour. Am. Med. Assn., vol. lviii, pp. 2026–2029, 1912.

[14] Walton, A. J.: Reconstruction of the Common Bile-duct. Surg., Gynec. and Obst., vol. xxi, pp. 269–275, Sept., 1915.

[15] Elliot, E.: The Repair and Reconstruction of the Hepatic and Common Bile-ducts. Surg., Gynec. and Obst., vol. xxvi, pp. 81–102, Jan., 1918.

[16] Sullivan, A. G.: Reconstruction of the Bile-ducts. Jour. Am. Med. Assn., vol. liii, pp. 774–777, 1909.

[17] Mayo, W. J.: Restoration of the Bile Passages After Serious Injury to the Common or Hepatic Ducts. Surg., Gynec. and Obst., vol. xxii, p. 5, 1916.

[18] Davis: Applied Anatomy. Fourth Edition, p. 421.

[19] Coffey, R. C.: Physiologic Implantation of the Severed Ureter or Common Bile Duct into the Intestines. Jour. Am. Med. Assn., vol. lvi, pp. 397–403, 1911.

[20] Balfour, D. C.: The Technic of Hepaticoduodenostomy, with Some Notes on Reconstructive Surgery of the Biliary Ducts. ANNALS OF SURGERY, vol. lxxiii, footnote, p. 345, March, 1921.

ACUTE PERFORATED ULCER OF THE STOMACH OR DUODENUM

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Acute rupture of the stomach or duodenum is generally recognized as a serious surgical indication for immediate hospital attention. The treatment received after admission varies with the operative methods of the respective surgeons under whose care the cases are placed. Twenty-four cases were admitted under the department of surgery during the past five years, *all* of which were operated upon by some one of six members of the attending staff by the simple practice of inversion and drainage. The fact that these operators, of varying ages and experience, used the same method for gastro-duodenal perforation and secured uniform results lends additional weight to the value of the method. Of these patients, with the single exceptions of one two-day and one three-day ruptures, all survived. These results give an operability for acute perforation of ninety-two, an operative mortality of none, and a total mortality of 8 per cent. No case was denied the chances of operative recovery even if the probability of survival were against him. Very good results have been reported by others on selected cases by the combined method of inversion and gastro-enterostomy. It is the purpose of this study to present the above cases in outline together with the rationale of inversion, only, for perforation.

The ages, sexes, and nationalities of the respective patients appear on the accompanying table. Aside from these possible predisposing factors of ulcers, no further observations will be noted at this time on the etiology of ulcer.

The location of these ulcers is represented diagrammatically by the dark shading for the most frequent site of occurrence and by the light lines for less common sites, see Fig. 1. All but one are found on the anterior surfaces of the oral one and a half inches of the duodenum and pyloric end of the stomach and 76 per cent. at the anatomical pylorus or within a distance of two inches of the sphincter. The one posterior rupture appears on the first part of the duodenum. The size of the callosity varies from a palpable hardening to an involvement of the whole pylorus and adjacent gastric and duodenal walls; the perforations from that of a pin's head to one and a half centimetres in diameter. Often the typical findings are the abnormal amount and alimentary character of the free fluid and gas within the peritoneal cavity and the evidence of irritation caused by contact of the stomach's contents with the peritoneum. Occasionally a high-pitched blowing sound is encountered

upon opening the belly. This hissing sound, due to the stomach's driving of gas and fluid through the rupture, varies with the size of the opening and with the tone of the stomach. The extent of soiling and the degree of peritonitis vary with the size of the perforation, the contents of the stomach, the motility of the stomach, and the length of time elapsed after rupture. Occasionally with small ruptures along the lesser curvature and on the posterior wall the contamination is taken care of by adhesive formation which converts an otherwise acute break into a subacute or chronic perforating

Table Covering the Acute Perforations of the Stomach or Duodenum Admitted and Operated upon during the past Five Years (1914-1919.)

No.	Name	Date Adm.	Age	Sex	Nationality	Duration of Prev. Hist.	No. Hrs. Elapsed	Surg.	Result
1	R. W.	4-29-14	26	F.	Russian	2 wks.	6	S.	Cure
2	I. N.	5-12-14	35	M.	Russian	8 yrs.	4	C.	Cure
3	T. O.	2-10-15	39	M.	Italian	2 wks.	48	S.	Fatal
4	M. S.	7-21-17	37	M.	Italian	?	2	S.	Cure
5	B. K.	1-3-17	28	F.	Irish	?	24	F.	Cure
6	R. H.	3-17-17	24	M.	U. S.	?	4	S.	Cure
7	J. C.	3-26-17	42	M.	U. S.	?	72	W.	Fatal
8	A. C.	3-29-17	27	F.	U. S.	3 yrs.	7	W.	Cure
9	R. B.	3-31-17	37	M.	Irish	?	22	S.	Cure
10	L. W.	6-4-17	27	M.	U. S.	1 wk.	8	W.	Cure
11	M. S.	7-10-17	45	M.	Austrian	?	6	D.	Cure
12	C. O.	8-25-17	46	M.	Sweden	2½ yrs.	24	H.	Cure
13	F. O'C.	9-22-17	36	M.	Irish	4 wks.	6	D.	Cure
14	M. B.	8-31-17	51	F.	Irish	?	?	S.	Cure
15	M. G.	10-19-17	?	M.	Hebrew	?	3	S.	Cure
16	P. H.	1-5-18	55	M.	Irish	?	6	S.	Cure
17	P. C.	11-24-18	54	M.	Irish	?	6	S.	Cure
18	R. G.	2-20-18	?	M.	Italian	?	4	C.	Cure
19	R. M.	6-15-18	24	M.	U. S.	5 yrs.	2	B.	Cure
20	C. P.	12-7-18	30	M.	?	2 yrs.	3	B.	Cure
21	H. H.	12-9-18	25	M.	Russian	2 mos.	5	B.	Cure
22	L. P.	3-25-18	31	M.	U. S.	5 yrs.	12	B.	Cure
23	W. G.	6-8-18	19	M.	U. S.	2 wks.	8	B.	Cure
24	M. H.	6-17-19	23	M.	U. S.	0	6	B.	Cure

NOTE.—The letters S., D., W., F., and B., designate the operators: Stewart, Douglas, Cramp, Wadhams Foskitt, and Barber, respectively.

ulcer. The liver, gastrohepatic omentum, pancreas, and rarely the transverse colon have been found in such instances the important barriers against free soiling. The frequency of concealed perforation represented by some is not borne out by the statistics of Symmers from the autopsy records of Bellevue Hospital. In this series, excluding two moribund cases of forty-eight and seventy-two hours, respectively, three individuals present themselves between twenty and thirty hours after rupture and the remaining nineteen before twenty hours, making an average of eight hours. In most instances the colon bacillus has been recovered from the peritoneum, in one individual, six hours after the onset of the acute pain, which probably marked the occurrence of the pyloric rupture. The streptococcus and staphylococcus have been less frequently found. Although the colon organism has been recovered from the presumably normal stomach, experimentally, it is

probably true that the peritonitis met with in the earliest hospital cases is non-infectious.

The pathology explains the sudden onset of agonizing upper abdominal pain with prostration, the board-like rigidity and exquisite tenderness, the hissing sound, if present, of gastric emptying through the rupture, and the polyneucleosis. It is important to observe the sudden onset of dyspnœa, the rapid costal breathing, and the sharp pain whenever the diaphragm is thrown in. Pneumonia, pleurisy, tabes, gastric dilation, gastroduodenitis, the lead colics, etc., should be excluded. Other conditions which have presented themselves for differentiation are influenza, pneumococcus peritonitis,

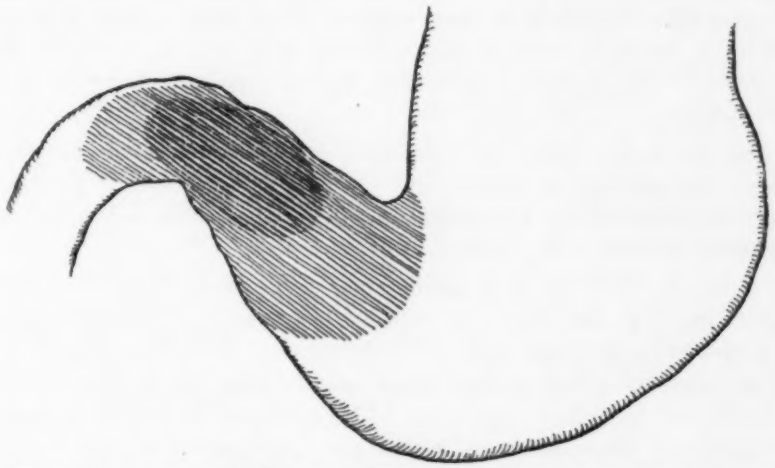

FIG. 1.—Diagram representing by dark and light shading the more and less frequent locations of perforated ulcers of the stomach and duodenum.

acute hemorrhagic pancreatitis, perforative cholecystitis, ruptured appendicitis, and mesenteric thrombosis.

Influenza, occurring during the fall and winter, may present extreme abdominal pain and rigidity while the local tenderness does not remain as definitely epigastric. Distinguishing points should appear in the history. One individual, complaining of pain in the lower left quadrant and presenting rigidity and tenderness in the upper right quadrant, disclosed, at operation, a thin sero-fibrinous exudate on the hepatic flexure and leaves of the meso-sigmoid and developed broncho-pneumonia two days post-operative.

Pneumococcus peritonitis occurred in one instance in an adolescent male without history and without signs of lung involvement either before or after operation. There were sudden onset of abdominal pain, vomiting, and generalized peritonitis. In this particular case the "terminal ileum contained lymph follicles which stood out visibly and lymph-nodes in the mesentery of the terminal ileum, measuring 2 to 5 cm. in longest diameters." The pneumococcus was recovered from the exudate and from the appendix. Recovery followed appendectomy.

In acute hemorrhagic pancreatitis, the individual resembles the gall-bladder type of patient and often gives a history and symptoms suggestive of cholecystitis. The pain is severe, the tenderness epigastric and right lumbar, and both are far out of proportion to the rigidity, which is not very marked.

Perforative cholecystitis in the early hours is characteristic of gall-bladder disease, when general peritonitis has developed it may be impossible of differentiation. The same is true of acute appendicitis which should be suggested before peritoneal involvement by appendical skin hyperalgesia.

Mesenteric thrombosis occurred once in the hospital series in a Bohemian of forty, who gave a history of abdominal pain and vomiting for one day and generalized tenderness and rigidity. Operation revealed obstruction well up in the mesenteric vessels and total gangrene of the small gut. In this instance the rigidity was marked, but the most tender point appeared to be below the umbilicus.

The operative methods recommended, include excision, inversion, gastro-enterostomy, pyloric occlusion, and combinations of these. Excision and pyloric occlusion are of theoretical interest only; inversion with or without gastro-enterostomy is the operation of choice.

In the present series inversion and drainage, with or without plication and omental grafting, have been the rule of practice. Gastro-enterostomy was not performed in a single case. This treatment is as follows: Each perforation upon entering the surgical ward is gone over by the house staff and prepared for immediate operation. Urine, blood, and blood-pressure are examined and, after diagnosis, morphia is administered to allay shock. In the proper cases transfusion is arranged for. The incision is upper right rectus; in the doubtful cases an opening may be made at the umbilicus and enlarged upward or downward as the indications warrant. To further combat shock, the intra-abdominal work is made as speedy and as accurate as possible and all peritoneal traumata are kept at the minimum. Cleansing of the peritoneum is accomplished by removing with forceps any coarse food particles that may be present and by aspirating the surplus fluid with a sucker. The stomach and duodenum are mobilized by holding conveniently in moist gauze pads while the ulceration is inverted by one or more purse-strings or by interrupted Lemberts of chromic gut. In the extensively indurated ulcers, the duodenum is freely plicated over the pyloric end of the stomach. When practicable, the omentum is tacked over the site of inversion. Drainage is based upon the extent of peritoneal soiling; *in situ* cigarette drains are used in every case, upper right lumbar drains through stab wounds in selected cases, and, in the majority of individuals, additional pelvic drains are left in the lower angles of the abdominal wounds. In the one exception in which no drainage at all was instituted, the patient poured out excretions from between the sutures. Cultures are taken, and all wounds are closed in layers with interrupted sutures.

FIG. 2.—Control, one day after ether anæsthesia and laparotomy. Note distended stomach and duodenal cap. (Exp. No. 25.)

FIG. 3.—Control one day after ether anæsthesia and laparotomy. Note—Stomach empty 5 hours after bismuth meal with head of column in colon and tail in ileum.

FIG. 4.—Pyloric perforation 3 days post-operative. Note stomach and obstructed "cap." (Exp. No. 90.)

FIG. 5.—Pyloric perforation 3 days post-operative. Note—5 hours after bismuth meal; residue in stomach, duodenum and small intestine; head of column in sigmoid (not labe'ed on print but seen lying cauded of mass of small intestine).

FIG. 6.—Pyloric perforation 4 days post-operative. Note—stomach obstructed "cap" and duodenal filling. (Exp. No. 91.)

FIG. 7.—Pyloric perforation 4 days post-operative. Note—5 hours after bismuth meal, empty stomach; column with head in descending colon and tail in ileum. (Exp. No. 91.)

FIG. 8.—Microphotograph of healing 3 day perforation. Epithelium (A) is beginning to bridge in gap between edges of wound. Note fibrous plug of scar tissue (B).

The post-operative care is that of peritonitis. Most patients are placed in the Fowler position; selected cases are left prone or in the head-down position, depending upon the location and extent of peritoneal soiling. Fluids are supplied by rectum. Patients are kept warm by external heat and quiet by the use of morphia, if necessary, for the first forty-eight hours. The time of feeding depends upon the patient's desire for food, for the onset of the patient's hunger contractions seems to be the most dependable guide. Most of these crave water, which is given on the third day. Albumin water and milk are given in increasing quantities on the succeeding days until a fairly generous ulcer-diet is allowed at the end of three weeks. By this time the patients are up and about the wards ready for discharge to a convalescent ward, if possible, for by this means the diet and general care of the patient may be supervised for five to seven weeks, or, if this cannot be arranged, the convalescents are discharged under instructions to report for periodic observations in the follow-up clinic.

The complications in this series have been diaphragmatic pleurisy in one case, acute pneumonic phthisis in another, and delayed wound-healing requiring secondary suture in another. Every case was given a chance of operation including the two- and three-day cases, one of which, in spite of transfusion, died upon the operating table and the other soon after returning to the ward. All the remaining of the twenty-four cases recovered uneventfully.

The follow-up care of these patients has consisted, as far as possible, in keeping them under observation or in getting them to report by answer to questionnaire on their conditions. An analysis of replies covering the past one- to five-year cases shows that in most instances these people have returned to their former habits and occupations and that they consider themselves cured or satisfactorily improved. There is occasionally pyloric impairment enough to give a six-hour residue. There are "occasionally gas disturbances," "occasionally gas and pain," and in two instances "vomiting occasionally." Of these vomiting cases, one gained fifteen pounds and the other twenty pounds in weight. One individual who reported "occasional pain" and a gain in weight of sixteen pounds volunteered the information that he had pain "only after overeating." These reports compare favorably with the chronic ulcer cases upon whom gastro-enterostomies have been performed.

This method of treatment is two-fold; namely, that of the acute patient first brought into the hospital and that of the discharged patient during observation. The indications of the acute stage are taken to be closure of the perforation and drainage; those of the discharged patient, the possible appearance of surgical obstruction of the pylorus. To date there has been no secondary treatment, not because all the patients have been entirely symptom-free, but because no one patient would acknowledge that he was sufficiently uncomfortable to allow himself to be reoperated upon. This

experience corresponds with Gibson's New York cases and with the twenty post-operatives followed by Wright in Stewart's St. Vincent's cases.

The rationale of simple inversion for perforation as opposed to inversion with gastrojejunostomy is further borne out on the experimental stomach. Pyloric stenosis, present at the time of operation or thought likely to appear thereafter, is taken as the indication for anastomosis. Obstruction at the pylorus is believed of frequent occurrence after a plastic of the kind above described, but it is thought to be transitory in nature and to have largely disappeared by the time of onset of hunger contractions. To illustrate the repair of a perforation at the pylorus and the return of the pyloric canal to normal function after inversion, plication, and grafting, the stomachs of five dogs were perforated, closed, X-rayed, and sectioned.

Experimental Technic: The pyloric sphincter of each of five dogs is perforated by means of a cautery iron and closed by inversion by means of two purse-string sutures, by plication of the duodenum across the anterior face of the pyloric end of the stomach, and by tacking the available omentum over the site of the inversion. In order to eliminate the gastric inhibition due to the ether anæsthesia and laparotomy, a control-animal was anæsthetized and a laparotomy performed exactly as in the case of each of the other animals but nothing whatever was done within the abdomen. The animal was given water by rectum and nothing by mouth as were all the animals. Each dog was given a 300 c.c. zoolack-bismuth emulsion and X-rayed for outline and emptying time. The control was X-rayed after one day, the perforations on the first to fifth days post-operative. After radiographing each of the five inversions, the stomach was removed, photographed, and the specimen microphotographed.

It is to be emphasized from the above technic that closure of the perforation is carried out so as to give the animal the maximum of protection against possible leakage without any idea of preventing pyloric obstruction. Under these conditions, clinically, pyloric stenosis might be considered probable and, for that reason, gastro-enterostomy might be indicated.

The behavior of these experimental stomachs corresponds with the clinical courses of human cases.

Röntgenological Findings: (Based upon radiographs by L. T. Le Wald, q. v. 2–7.) Stomachs distended with opaque meal in all. Hypermotility accounting for spontaneous initial emptying. Pylorospasm recorded in all the animals. Filling defects in pyloric portions or in duodeni of all, due to spasms or deformities. Five-hour retention in one-, two- and three-day dogs and complete emptying in four- and five-day animals. Control shows active motile pyloric part, "cap," and total clearance within the five-hour interval. The progress of the bismuth columns in the remaining intestinal tracts may be seen in part on the accompanying röntgenograms.

From the X-ray standpoint the normal stomach may be expected to empty under the above experimental conditions in three and one-half hours, the stomach one day after an abdominal wound and anæsthetic shows retrostalsis (vomiting) and a one-hour delay, stomachs with obstructed pyloric outlets, as above described, develop hypermotility, including pylorospasms, during the first three days and hypermotility without obstructing spasms on the fourth and fifth days post-operative.

That this delay is, in part, purposeful or protective, appears from the gross and microscopical pathology (*Cf.* 8 and 9–13, author's notes).

Surgical Pathology (gross): Approximately six hours after the bismuth meals the stomachs of all five animals were examined. All appear fairly well contracted. The distorted pyloric ends and duodeni appear very much as left at operations but this distortion seems to have been somewhat overcome by a straightening out of the stomachs in the fourth- and fifth-day animals. After opening the stomachs the tips of the little fingers could be passed through the pyloric canals of the fourth- and fifth-day stomachs, but not through those one to three days post-operative. These findings correspond with the infolding which appears more evident during the first three days. The perforative wounds are tight and amply protected (microscopical). Fraser found the inverted edges in close contact in all, œdematous swelling in the one- to three-day specimens, and fibrous bridging and epithelialization in the later sections. (Fig. 8.)

It is believed that the letting-up of the gross mechanical obstruction, the microscopical repair, the disappearance of obstructive pyloric spasms, and the return of hunger contractions as early as the fourth and fifth days, emphasize the transiency of the stenosis resulting from inversion and plication.

SUMMARY

(1) This report is based upon twenty-four acute perforated ulcers of the stomach and duodenum coming under the department of surgery during the last five years.

(2) All were given a chance of operative recovery and with the single exceptions of one three-day and one two-day perforations all survived. The operative procedure in each instance was inversion and drainage with or without plication and omental grafting.

(3) Gastro-enterostomy has not to date appeared indicated in the subsequent courses of these patients. The rationale of inversion appears further borne out by a study of the surgical pathology of perforation in the normal stomach.

BIBLIOGRAPHY

[1] Symmers, Douglas: Personal Communication.
[2] Wright, Arthur M.: Personal Communication.
[3] Gibson, Charles: Surg., Gyn. and Obstet., April, 1916, pp. 388–398.
[4] Fraser, Alexander: From the Path. Dept. Report, 1920.

BLIND-END CIRCULAR SUTURE OF THE INTESTINE, CLOSED ENDS ABUTTED AND THE DOUBLE DIAPHRAGM PUNCTURED WITH A KNIFE INTRODUCED PER RECTUM

By William Stewart Halsted, M.D.
of Baltimore, Md.

The last word on the subject of intestinal suture may some day be written, but surely not until much experimental work has been done with an exactness not hitherto contemplated in investigations of this nature. Authors of text-books and of papers lend their indorsement to some particular variety of suture without offering plausible argument for their preference other than a certain measure of success which has attended its employment in their hands; and faulty methods succeed so well that interest in the relative merits of the details of the various procedures has not been sufficiently aroused to demand greater precision in the experimentation and the critical analysis.

Who knows, for example, how much of the intestinal wall should be turned in; whether two rows of stitching are better than one; whether the suture should be continuous or interrupted; whether the Lembert or mattress stitch is preferable; if the knots should be on the mucous or on the peritoneal surface; why some stitch-loops (knots outside) fall into the lumen and others remain on the peritoneal surface; who has considered the factors facilitating or delaying the release of the inturn; and who, indeed, has endeavored to estimate the weight of the burden thrown upon the experimentee to counteract the operator's shortcomings?

Assuredly there is no subject in surgery which has received experimentally a tithe of the labor devoted to intestinal suture. Lives there, indeed, a surgeon who has not made experiments in suturing the intestine—if not on animals, then on man?[1] Such performance on the human subject without rehearsal on animals is a ruthless play with human life, advancing knowledge scarce a tittle.

Last winter, at one of the monthly meetings of the Johns Hopkins Hospital Medical Society, Doctor Holman and the writer reported[2] the results

[1] In our laboratory operative courses for students of the Johns Hopkins Medical School the leading topic from the time of the introduction of these exercises in 1895 up to the present year has been intestinal suture. I embrace this opportunity to express my indebtedness to Harvey Cushing, for thirteen years my brilliant assistant, for his zeal in elaborating these courses and placing them on such a substantial basis that they are now regarded as one of the dominant features of the surgical curriculum for the third-year medical students at the Johns Hopkins University, and are being adopted by other medical schools of this country.

[2] V. S. Halsted and Emile Holman: An End-to-end Anastomosis of the Large Intestine by Abutting Closed Ends and Puncturing the Double Diaphragm with an Instrument Passed Per Rectum. Johns Hopkins Hosp. Bull., 1921, vol. xxxii, p. 98.

of a few experiments having for their object the development of an end-to-end suture more nearly aseptic than had hitherto been devised. The bulkhead suture[3] had taught me that without danger of resulting obstruction, the inturn of intestinal wall (the flange) may be much greater than is generally supposed, so great indeed as quite to fill the lumen of the gut; and the highly instructive and too little known experiments of my former assistant, Dr. Willis D. Gatch,[4] convincingly support this assertion.

In the course of the speculations, which eventually led to the development of the bulkhead suture, I had entertained and discarded the idea of trusting to the absorption of a catgut purse-string to reëstablish the intestinal lumen occluded by the double diaphragm of abutted closed ends, and wrote of it as follows (*l. c.*, p. 217): "But a double diaphragm remains to impede for a long time the advance of intestinal contents even if the ligature employed in the tying off of the gut could be relied upon to melt away with the desired promptness." Evidently I did not realize at the time how great the inturn might safely be. Later we ascertained that the amount inverted by the bulkhead method proved to be even greater than in the blind-end suture which it is the purpose of this communication to describe, and produced no obstruction nevertheless.

At the outset of the recent experiments outlined in our report to the Johns Hopkins Hospital Medical Society last winter, I had it in mind to seek a method which at least might be applicable to such cases destined for excision of the large intestine as had previously been provided with a colostomy. Doctor Holman and I found that dogs tolerated quite well what we believed to be a complete obstruction of the descending colon for four days or more, the time apparently required, as a rule, for the disintegration of the catgut (No. o doubled) purse-string ligatures with which the abutted blind ends had been closed.[5]

Soon after making our report it occurred to me to test the feasibility of dividing the purse-string ligatures, or at least of puncturing the double diaphragm by a protected cautery wire, or knife, or knives passed from below —per rectum. The cautery was soon abandoned, being considered dangerous and too complicated. The knives—at first one, later three, and finally four—housed in a short cylinder of wood or metal were tested. I believed in the beginning that the cylinder should approximately fill the bowel in order to centre the knife and thus insure the cutting of the purse-strings, but soon

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[3] W. S. Halsted: A Bulkhead Suture of the Intestine. Jour. Exp. Med., 1912, vol. xv, p. 216.
Ernest G. Grey: Studies on the Aseptic End-to-end Anastomosis of the Intestine. Johns Hopkins Hosp. Bull., 1918, vol. xxix, p. 267.

[4] Willis D. Gatch: Aseptic Intestinal Anastomosis. An Experimental Study. Journ. A. M. A., 1912, vol. lix, p. 185.

[5] Unsterilized or "raw" catgut seemed to dissolve more quickly than the sterilized, but it was not so strong, and Nos. 1 and 0 would frequently break on the tying of the purse-string.

found that these cylinders might actually prevent the centring of the knives unless the stitches were precisely equidistant from the centre.

One knife proved to be better than three or four because (1) less force was required to cut the ligatures or perforate the diaphragms, and (2) one of the three or four knives (blades parallel and both edges of each knife sharpened) might engage the mucosa of the intestinal wall at the margin of or just below the inturn.

The Method.—The vessels supplying the portion to be excised are occluded by fine transfixion ligatures carried by milliners' needles, and are divided as shown in Fig. 1. Strong Kocher clamps are applied, one at the distal, the other at the proximal end of the piece deprived of its circulation. Along the proximal edge of the mark made by the proximal clamp, and along the distal edge of the mark of the distal clamp, a finely basted purse-string stitch of silk [6] is run with a milliner's needle; these ligatures are drawn home and only a half knot taken in each; the knots are completed at the moment the intestine has been divided with the electric cautery wire. Prior to the burning, stout threads are tied about the isolated segment at a suitable distance from the basting stitches (Fig. 2). The purse-strings can be drawn tighter after the tension caused by the encircling threads has been relieved by the severance of the gut. After the burning, the little overhangs, which may at the discretion of the operator be further sterilized chemically or by the electric wire, are trimmed with scissors as close as feasible to the purse-strings. It is hardly possible to cut these threads in the trimming process, and hence, without fear, one snips the little teat of everted bowel wall completely away (Fig. 5).

For the suturing, a single row of mattress stitches suffices. The first five of these (stay stitches), drawn home and tied, facilitate the introduction of the others and serve as guides to their proper placement. The order in which the stitches have usually been taken is shown in Figs. 6, 7 and 8. The two at the mesenteric border are placed a little closer to each other (Fig. 7, insert) than the remainder, and are the first to be tied.

The suturing having been completed, the dog is drawn down until his buttocks overlap the edge of the operating table. An assistant then introduces per rectum the instrument with which the purse-strings are to be cut. Figs. 10, 11, 12 and 13 depict the manœuvres so well that explanatory notes are hardly necessary. The purpose of the short piece of rubber tubing is to protect the sphincter from the sharp edges of the knife and to facilitate its introduction into the rectum. This tube is left in the position shown in Fig. 10 until the knife has been withdrawn.

The knife point, protected by a little piece of cork on the tip, is

[6] Silk was used for the purse-strings to exclude the possibility of misinterpretation of the results. Were the purse-string ligatures of catgut one could not be sure that the restoration of the bowel's patency was due to the cutting of these ligatures and not to their dissolution.

FIG. 1.—Ligation of the blood-vessels by transfixion.

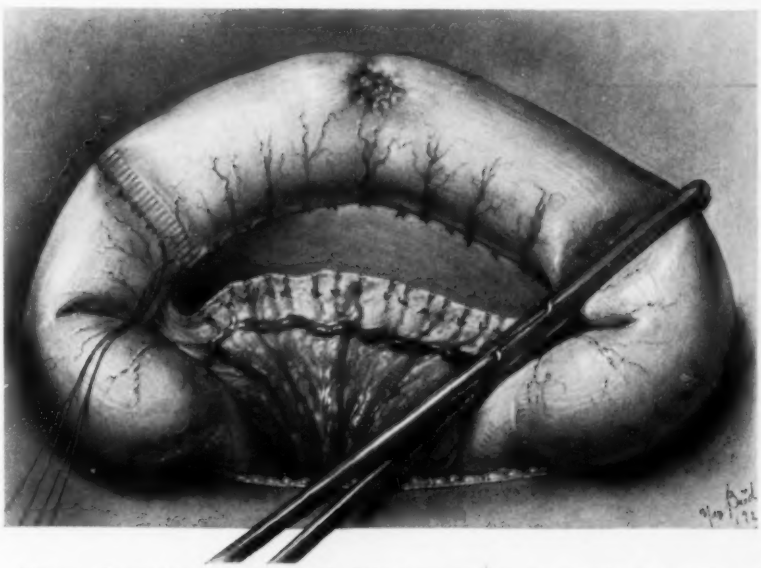

FIG 2.—The marks made by the crush of the clamp serve merely to guide the placing of the finely basted purse-strings.

FIG. 3.—Purse-strings tied with half knots; stout ligatures on the piece to be resected.

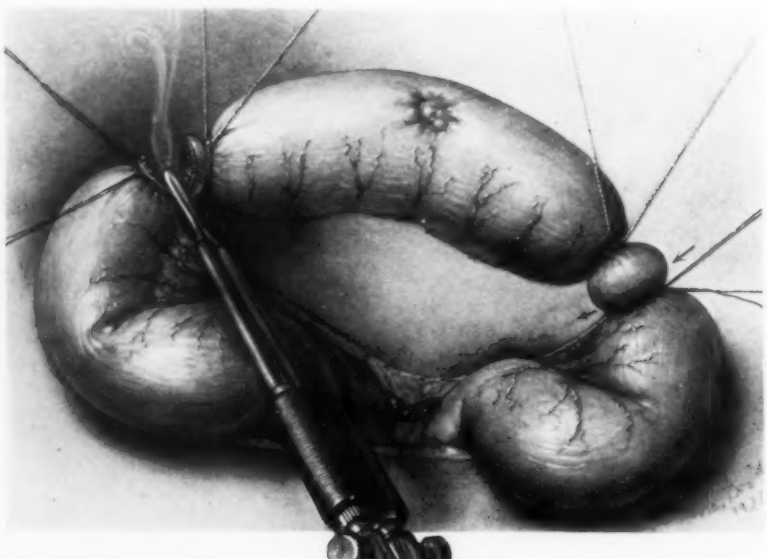

FIG. 4.—After division of the bowel with the cautery the purse-strings are tightened and their knots completed.

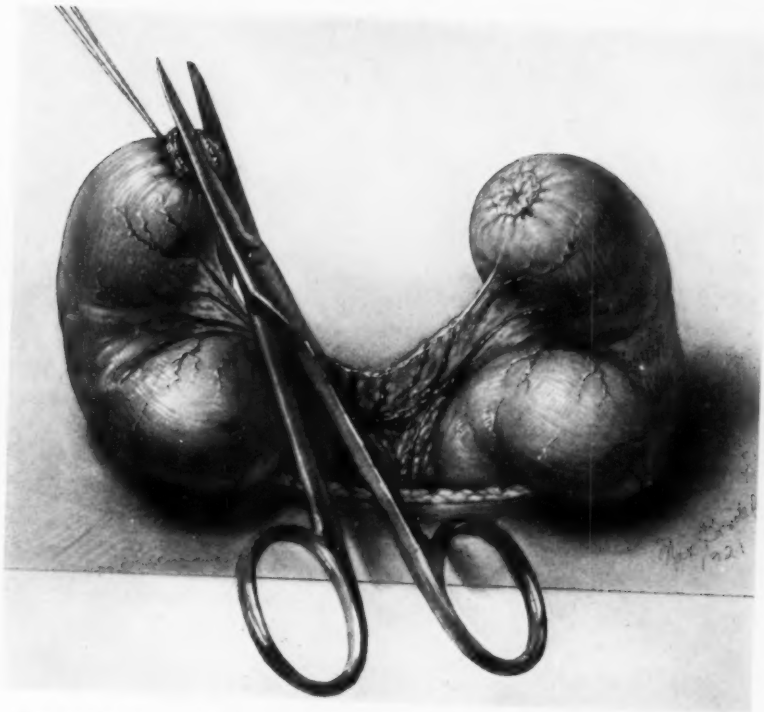

FIG. 5.—The overhang may be trimmed as close as possible without fear of cutting the purse-strings.

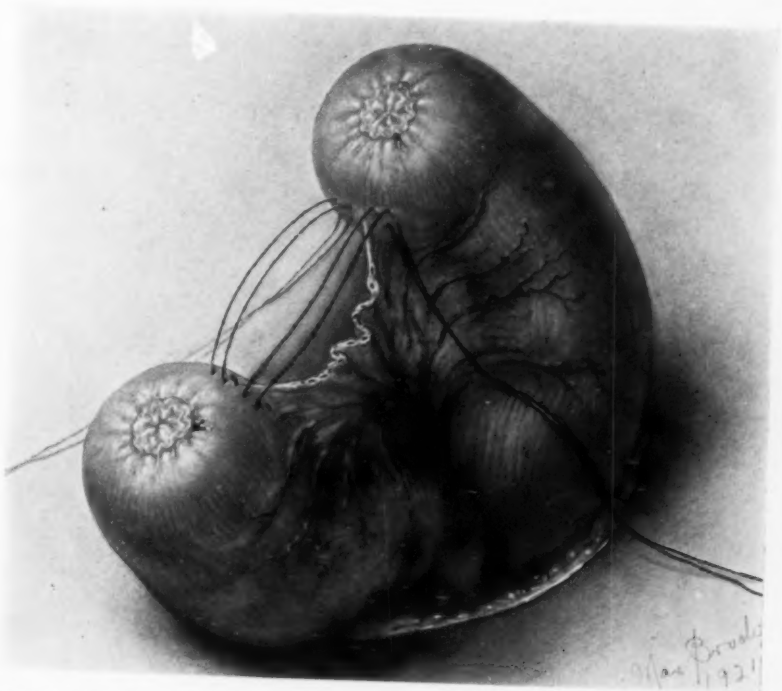

FIG. 6.—The first of the mattress stitches, one on each side of the mesenteric border.

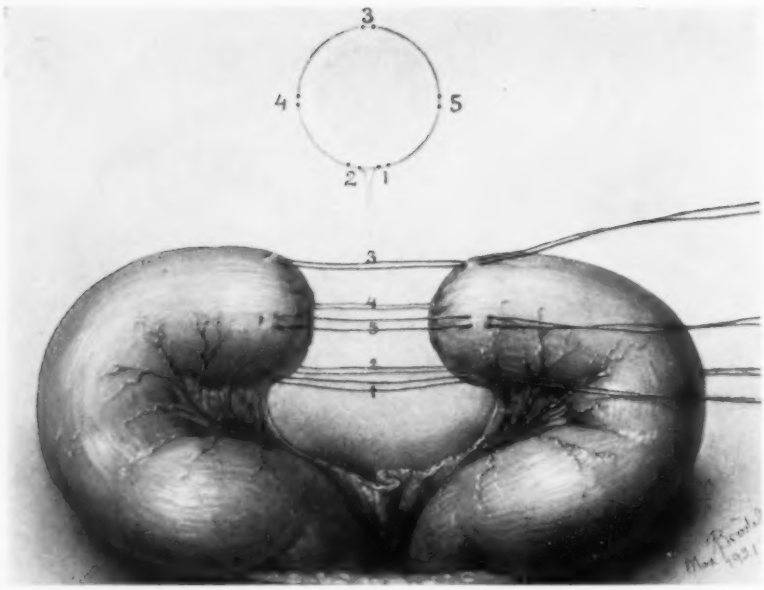

FIG. 7.—The five stay stitches; the numerals indicate the order in which they are taken.

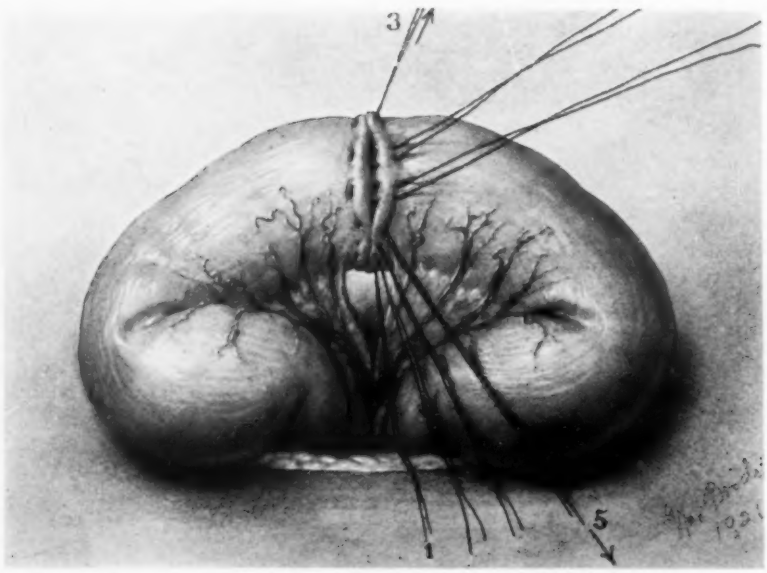

FIG. 8.—Traction on the stay stitches facilitates the taking of the intervening ones.

propelled to the required distance by the assistant who manipulates the flexible metal tail (gas tubing) of the instrument. With no more, or rather less, pressure than is required for the introduction of a stomach tube, the knife will glide along the dog's bowel to the ileocæcal valve. When the knife reaches a point in the pelvis easily accessible to the operator's hand it may be guided by him through the remainder of its course to the double diaphragm; but it rarely needs such guidance. The slightest obstacle to the progress of the knife is detected by the assistant in charge of its trailer or tail. The cork having been removed (Fig. 12), it is slid down the bowel and out of the way (Fig. 13). In making the thrust the operator grasps the metal tubing quite close to the shank of the blade and aims for the centre of the diaphragm, hoping thus to cut both of the purse-strings (Fig. 13). Whether these happen to be divided or not would seem, judging by the results, to be immaterial, nevertheless one should make two or three thrusts at slightly different spots, but all as near the centre as possible, in the endeavor to cut these ligatures. The more experienced the operator the better he can sense the greater resistance to the point of the knife offered by the tissues so tightly compressed by the purse-strings. As a precautionary measure a tapered bougie is passed through the diaphragm before closure of the abdominal wound (Fig. 14).

Forty-seven dogs have been operated upon by this method without a fatality and without symptoms indicative of an abnormal convalescence. The bowel resected was in every instance the colon. The operations were performed by my former and present assistants and myself, some of them by recent graduates of our school without operative surgical experience. The initial experiments were made with an extemporized instrument—a knife housed in wood and mounted on a brass rod. From the outset, however, it was our intention to have a flexible trailer in case the results with our crude apparatus seemed promising. Notwithstanding the defects of the unwieldy home-made instruments used in the earlier experiments and the lack of experience of several of the operators, not a single death occurred.

Hardly a year had passed since 1886 when with the assistance of Dr. Franklin P. Mall I made many experiments in intestinal suture,[1] without further experimental investigation of this subject on the part of my assistants and myself. Not one of us (Gatch, Grey, Holman, Halsted) had a series of more than twenty-three dogs without a death. The present series, therefore, of forty-seven consecutive successes being the longest for our laboratory and, so far as I know, hitherto unequalled elsewhere, it would seem worth while to offer it to the profession for trial and criticism.

It will readily be conceded for this method that the amount of soiling

[1] W. S. Halsted: Circular Suture of the Intestine—an Experimental Study. Amer. Jour. Med. Sci., Phila., 1887, n. s. No. 188, p. 436.
F. P. Mall: Healing of Intestinal Sutures. Johns Hopkins Hospital Reports, Baltimore, 1896, vol. i, p. 76.

could hardly be less; it is little more than occurs in a simple, properly performed appendectomy.

For the first time therefore in the history of intestinal suture two of the factors, the soiling and the amount of inturn, have been reduced almost to a constant, and hence we are now better prepared to test on animals the relative merits of the various stitches in common use.

In operations on the human intestine the surgeon's only criterion has been the mortality; for one cannot explore the abdomen of his patient every few hours after operation in order to determine the amount of reaction (infection and adhesions) about the line of suture, the fate of the stitches, the depth of the inturn, the delay in its unfolding, etc.

Unembarrassed by soiling, or eversion of the mucous membrane, or the presence of a single clamp or other instrument, or by the fear that the mesenteric border may be imperfectly inverted, or that the amount turned in may be too great or too little, or that some point of a running stitch may have been too loose or too tight, the operator proceeds in orderly and uniform manner from the beginning to the end of the performance.

In addition to the two constant factors mentioned above—the amount of soiling and the amount turned in—it is possible, at least in experiments upon the dog, to have another constant factor, *viz.*, the depth to which the stitches penetrate. One may learn in a few minutes to sense the submucosa with the point of the needle and to include a part of it in the stitch without entering the lumen of the gut. With a little practice one learns not only to pick up a thread of the submucosa but to press the needle along in the plane of this coat. The resistance in the latter case may be so great as to remind one of that experienced in the taking of subcuticular stitches. Members of our upper surgical staff can all testify to the accuracy of this statement. And who will not assent to the view that it is desirable to take the submucous stitch when this is feasible? Experience has taught us that stitches which do not enter the mucous coat become ultimately subperitoneal loops, and long before the diaphragm or flange has unfolded. Uninfected, they are cast outwards, and not discharged into the bowel's lumen; whereas, the perforating stitches seem usually to ulcerate their way into the gut. We sometimes find one or more of these perforating stitches hanging in or near the line of suture even when the unfolding process is about complete—when little trace of the diaphragm remains. In the track of all of these stitches which are discharged into the bowel there has necessarily been an infected sinus from the moment of their placement until their release. Dr. Florence Sabin,[8] in her elaborate and unique study of the healing of Doctor Holman's end-to-end anastomoses of the intestine, rarely found that a stitch had perforated; when this had occurred in ever so slight degree there was inflammatory reaction, sometimes a small abscess, about the silk thread.

[8] Florence R. Sabin: Healing of End-to-end Intestinal Anastomoses with Especial Reference to the Regeneration of Blood-vessels. Johns Hopkins Hosp. Bull., 1920, vol. xxxi, p. 289.

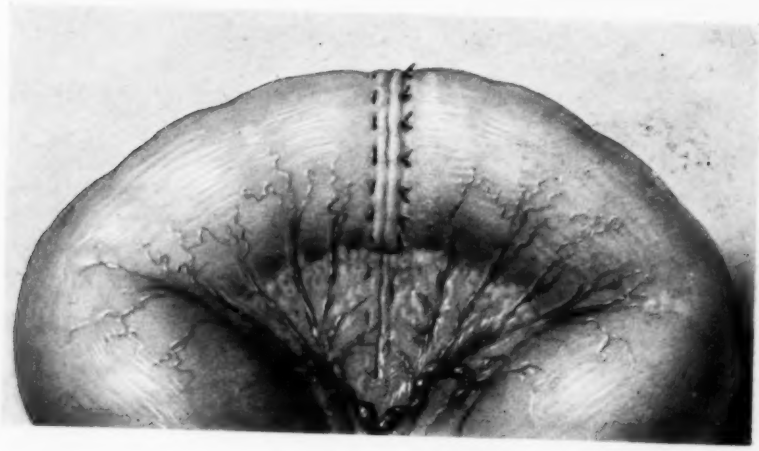

FIG. 9.—Suture completed.

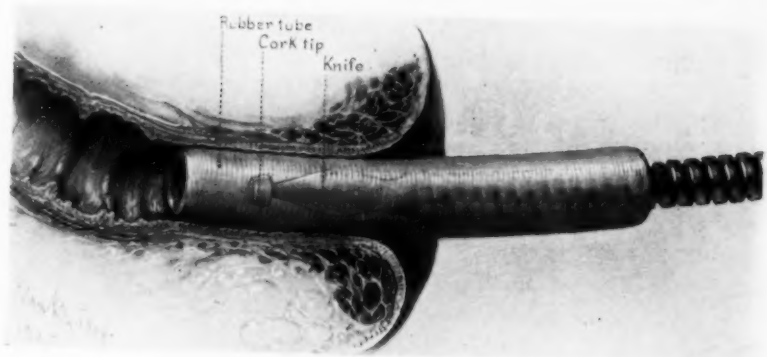

FIG. 10.—The knife in transit through the rubber tube which protects the sphincter.

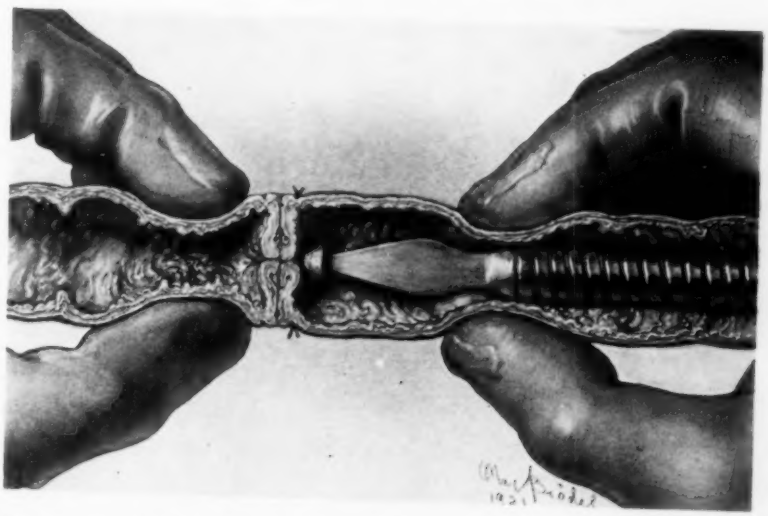

FIG. 11.—The knife has been pushed up to the diaphragm by the outside assistant.

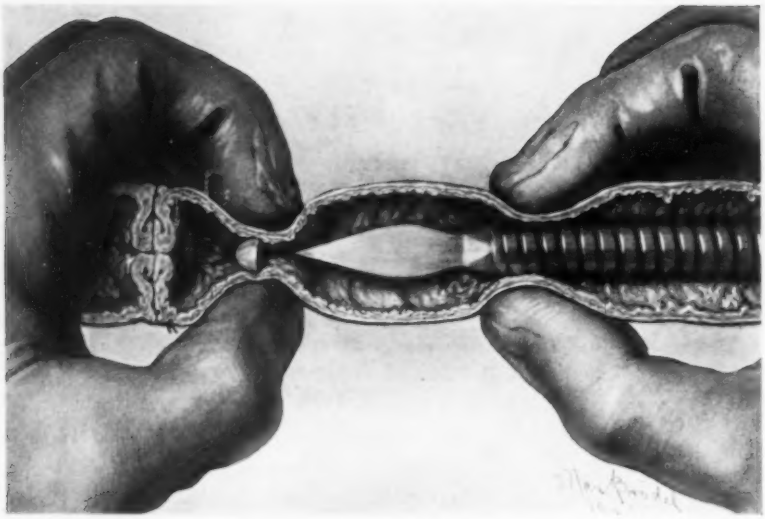

FIG. 12.—Removal of the cork

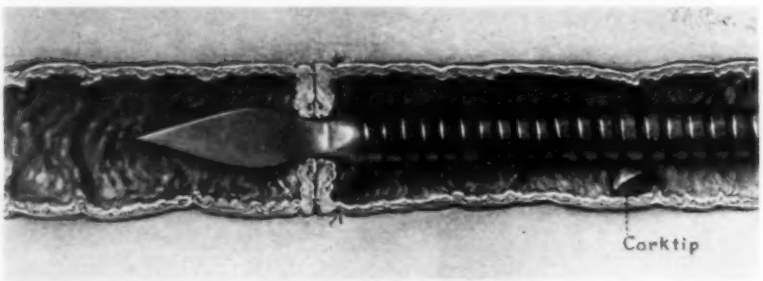

FIG. 13.—The cork pressed downwards and the purse-strings divided.

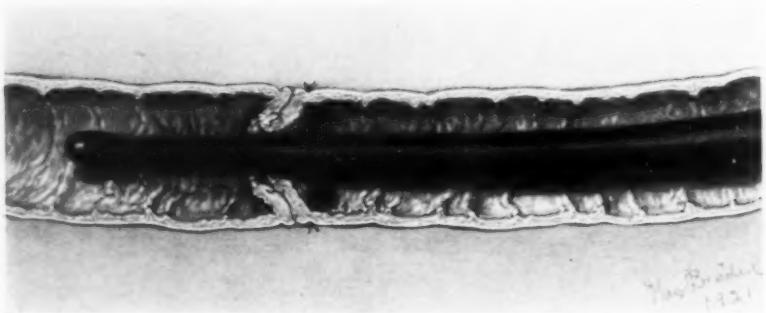

FIG. 14.—Bougie passed for control.

Sutures falling into the lumen of the bowel, being quickly transported, are lost; only such are discoverable as happen still to be attached to the intestinal wall when the animal is sacrificed. Those discarded on the peritoneal surface may remain for several years and be distinctly seen shimmering under an endothelial film. The more perfect the operation the fewer the adhesions, and frequently one finds every one of the loops outside if the mattress stitches have been happily made. Undoubtedly in the hands of novices most of the stitches penetrate the mucosa; nevertheless many of these perforating mattress stitches cut their way outwards; when they have pulled through the mucosa, the fistulous tract becomes sealed from within and the suture's passage towards the peritoneum may thereafter be a clean one.

The slogan "knots inside" naturally makes an appeal, for it seems universally to be taken for granted that the threads necessarily work their way into the lumen. Year after year for thirty-five years I have had opportunities to convince myself of the fact that in the cases which heal most ideally the stitches come to the peritoneal surface. The omental adhesions to the line of suture in such cases are very light (occasionally they are absent) and in a few weeks, in a few days even, may be absorbed and have left no trace.

Consulting the original paper of Lembert,[9] I was interested to find that his stitches were cast off into the bowel. He states this definitely and makes no mention of having ever seen at autopsy a loop of thread shimmering under the peritoneum. This fact of itself suffices to prove that his stitches, contrary to the universal belief, were perforating ones. But we do not require this particular proof, for he distinctly states that he intentionally entered the lumen of the intestine with his needle, except when the wall was thick; and in this event the needle *glided*[10] between the coats. Now it is questionable, I think, that even in the thick-walled cases he slid the needle between the coats without entering the intestinal lumen. He apparently knew nothing of the existence of the submucosa, and his needle, if it "glided," must have passed on one side or the other of this coat—either between the muscular and submucous coats, or between the latter and the mucosa; it could not *glide* along *in* the tough submucous coat. If the stitches had included only the peritoneal and muscular coats they would have split the longitudinal fibres, have constricted or crushed the circular ones and at best have had an insecure hold; and if they had perforated the submucosa they undoubtedly entered the intestine's lumen. Thus, in all probability, Lembert's stitches quite invariably entered the lumen, whatever the thickness of the bowel's wall; and, in any event, Lembert intentionally perforated the wall unless it was thick. Hence the Lembert stitch has been universally misunderstood, and the erroneous

[9] A. Lembert: Mémoire sur l'entéroraphie, avec la description d'un procédé nouveau pour pratiquer cette opération chirurgicale. Répertoire gén. d'anat. et de physiologie pathologiques, etc. Paris, 1826, vol. ii, p. 100.

[10] A. Lembert, *l. c.*, p. 105: "L'aiguille pénètre à 2 lignes environ du bord saignant droit, dans la cavité de l'intestin, ou bien sa pointe glisse entre les tuniques musculeuse et muqueuse, suivant que l'intestin est plus ou moins épais."

description of some early author has been passed on from one writer to another until the present time. Picture the amount of soiling there must have been in Lembert's experiments. In placing his stitches he introduced a finger into the bowel, using it as a guide, as a darning ball.[11] Furthermore, the stitches perforated the intestinal wall and were discharged into the lumen. Nevertheless the five dogs upon whom he operated all recovered.

In the entire literature of intestinal suture there are, perhaps, no more impressive examples of nature's ability to protect against man's faulty operative methods than those furnished by Merrem's[12] resections of the pylorus (1809 and 1810).

Merrem excised the pylorus in three dogs—two in 1809 and one in 1810. In the first dog, attempts at invagination being unsuccessful, the raw edges of the stomach and duodenum were apposed and held by only three stitches. Death occurred on the twenty-third day from "inanition"; there was no peritonitis, and the suture-line was so well healed that no trace of it remained.

In the second and third dogs the stomach was invaginated into the duodenum—serosa apposed to mucosa. The second dog recovered; the third died. In all of the experiments the threads of the gastro-enterorrhaphy were brought out of the abdominal wound and fastened to the surface with adhesive plaster. The severed pyloric artery could not be tied on account of its depth; the hemorrhage was checked with sponge and spirits.

Let those of us who are inclined to be content with our present methods of end-to-end anastomosis bear in mind these experiments of Merrem and of many other early research workers and observe on animals the early stages of repair of our own intestinal sutures, to the end that we may understand the part that nature plays to protect the patient from the crudity of our handiwork.

Notwithstanding much experimentation, we have been unable to improve upon the method developed thirty-five years ago,[13] unless perhaps the procedure submitted in this communication shall prove to be an advance. We have at least learned in recent years that it is safe, and probably advisable, to make a deeper inturn, and have devised a cleaner procedure. It remains to be determined whether in the blind-end method the continuous suture

[11] Lembert, *l. c.*, p. 106: "Le chirurgien, . . . porte l'index de la main gauche dans la cavité de l'intestin, de manière à soutenir les bords saignans avec la pulpe de ce doigt."

[12] Merrem's paper (Animadversiones quædam chirurgicæ experimentis in animalibus factis illustratæ. Giessæ, 1810) is listed in the Index Catalogue of the Surgeon General's Library, but could not be located. Therefore I wrote to Professor Payr, who, unable to find it in Leipzig, kindly sent me Carl Langenbeck's abstract (Abschrift eines Referates von C. J. M. Langenbeck, Professor der Anatomie und Chirurgie, Direktor des chirurgischen Spitals in Göttingen, aus Bibliothek für die Chirurgie, 4. Band, 1. Stück. Göttingen. Rudolph Deuerlich, 1811). I appealed also to Prof. Felix Landois, of Berlin, who found Merrem's paper and sent me quotations from it which he had graciously translated into German.

[13] W. S. Halsted: Circular Suture of the Intestine—an Experimental Study. Amer. Jour. Med. Sci., Philadelphia, 1887, n. s., vol. xciv, p. 436.

will yield results as good as those we have obtained by the mattress stitches. Better they can hardly be.

For lateral anastomosis the mattress stitches possess the advantage that they can all be taken before the bowel is opened, that one row of them suffices, and that infection of one stitch is unlikely to be conveyed to the others.

As stated earlier in the paper, it is not known how deep the inturn should be. It may safely be assumed, however, that the deeper the inturn the better, provided obstruction is not produced by it. Granting this, how many rows of suture should be made? Fortunately the apposed serous surfaces of the diaphragm tend to remain firmly in contact. That the process of unfolding begins promptly we know from the rapid cutting outwards of the properly placed sutures as well as from early observations on the mucous side; and from this continuous effort to unfold we infer the force maintaining the peritoneal surfaces in contact from the line of suture to the raw edges. Every stitch, whether essential or superfluous, interferes more or less with the circulation, hence the necessity for eliminating any that may be unnecessary. In circular suture of the intestines of a variety other than the blind-end we have advocated (1887, *loc. cit.*) a few presection stitches, taken chiefly with the purpose of preventing the outward rolling of the bowel wall and thus facilitating the introduction of the mattress row.

If we bear in mind that every perforating stitch is a source of danger, however slight, as well as a menace to the circulation, our efforts will be directed towards the suppression of unnecessary stitches and the cultivation of the sense which makes possible the appreciation with the needle's point of the resistance offered by the submucosa. That in resection of the human colon one row of mattress stitches is better than two, I am not as yet prepared to affirm, but in the dog it has given results in the blind-end suture so perfect that I should regard a second row as a factor of danger rather than security.

The more perfect the execution of any method of end-to-end anastomosis, the less reaction about the line of suture and the greater the rapidity of the unfolding of the inturn, of the complete restoration of the lumen of the bowel. In one of our specimens, for example, little remained of the diaphragm on the tenth day; in another there was no trace of it on the seventeenth day. On the other hand, the inturn in one case was about as deep on the 109th day as at the beginning. An exceptionally bad result in this case (an early one) was predicted because the force required to puncture the diaphragms with the three broad knives was so great that the stitches (perforating ones) tore little streaks in the bowel walls. The operation was cleverly performed by an eminent European surgeon who had not practised the submucous stitch. The animal's recovery and normal convalescence were surprising; at no time in the 109 days after operation were there symptoms of obstruction. It will readily be understood that great reaction, causing matting of the omentum and intestines about the line of suture, may lead to the formation of fibrous tissue in the infiltrated intestinal wall so dense and so extensive as to delay for a long time, and possibly permanently

prevent the complete unfolding of the inturn. The surgeon should bear in mind this fact, unemphasized perhaps hitherto, and the experimentor in testing the relative merits of the various procedures for lateral as well as end-to-end anastomosis should note the rapidity of the unfolding and accept the tardy disappearance of the flange as evidence of a faulty technic either of method or execution or both.

The opportunity has not as yet presented at the Johns Hopkins Hospital to perform the blind-end suture on the human subject. We shall probably test it first on cases in which a lateral anastomosis is not feasible. The knife passes readily to the ileocæcal valve in the dog, and in one instance Doctor Holman, after resecting the cæcum, abutted the closed ends of ileum and ascending colon and cut the diaphragms with the knife; the dog recovered normally. When the splenic flexure is hooked high (Payr's Doppelflinte) it might be difficult without mobilizing to traverse it with the knife. But for resections of the descending colon, of the sigmoid flexure, of the rectum when the sphincter is to be preserved, and possibly of the gastric end of the œsophagus, the method deserves, I believe, a trial.

I am greatly indebted to Dr. F. L. Reichert and to Dr. Emile Holman for assistance in every phase of the work. Dr. Mont Reid also has most kindly aided me in many ways. A detailed report of the experiments will be made later by Doctor Reichert and Doctor Holman.

THE POTENTIAL MALIGNANCY IN EXSTROPHY OF THE BLADDER

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Aberrant epithelial tissue, undergoing malignant growth, is occasionally seen in unusual situations, especially in areas subjected to irritating influences. These unusual growths generally are the result of metaplasia, but occasionally they are the result of hyperplasia of tissue which is normally present in small amounts. The growths are usually composed of squamous cell tissue; they are occasionally associated with hyperplastic conditions of neighboring tissues, both may be the result of irritation. Bohm described a squamous cell tumor which had formed in the large intestine; the borders of the tumor gradually shaded off into normal glandular tissue. Nicholson collected nineteen cases in which squamous cell carcinoma had formed on the mucous membrane of the gall-bladder; in all but one the gall-bladder had been subjected to the irritation of stones. Deetz described a case in which the mucous lining of the gall-bladder was covered by a layer of squamous tissue. Zeller cited a case of squamous cell tumor of the body of the uterus in an area usually covered by glandular tissue. Broders noted the transition from squamous cell to basal cell and glandular formations in a case of carcinoma of the face.

The property of transformation of tissue is probably a characteristic inherent to the tissues themselves, the change being initiated by various forms of irritation or inflammation. Eichholz attempted to produce aberrant growths by the transplantation of tissue into unusual situations, but he was unsuccessful.

All exstrophied bladders show the results of irritation and trauma. Metaplasia and hyperplasia have gone on to such a degree that it is often difficult to find normal mucosa. The normal transitional epithelium has been replaced by an almost solid mass of glands. Vrolik, in 1822, first remarked on the curious mucous covering of exstrophied bladders. Lichtheim, in 1873, mentioned a complete glandular covering on an exstrophied bladder observed by him. Enderlen also observed this condition in several cases. He stated that it is impossible to determine at what age the condition develops; he found it in an infant of eighteen months. He studied the development of the urinary bladder in a series of embryos, and noticed that occasionally there was delayed formation of the urogenital sinus. This sinus or opening penetrates the cloacal membrane, which divides the primitive cloaca into the bladder and rectum, establishing the patency of the outlet of the bladder. Owing to this imperfect coördination of growth the bladder and its outlet

are not united at a period early enough to drain the urine from the embryonic bladder; consequently this viscus ruptures through the cartilaginous pubic bones and becomes an external organ. Another theory is that exstrophy is merely a continuation upward toward the navel of a normal splitting process that forms the anal opening.

Ehrich explains the presence of the glandular covering over exstrophied bladders from an embryologic standpoint. The bladder and intestines both come from the same source; due to its unusual situation the bladder has not the stimulation to change over to the usual type of transitional epithelium but retains that of the intestines. The work of Haché supports this theory; he collected six cases of exstrophy of the bladder in which the intestine and bladder were united, the intestinal opening persisting on the surface of the misplaced bladder. Enderlen's studies seem to disprove Ehrich's theory. In a number of exstrophied bladders from infants who died at birth he found a normal transitional epithelium. Evidently the glandular formation is not a result of embryonic changes but occurs in response to some stimuli developing after birth.

In exstrophied bladders from adults extensive glandular formations may be found in almost any area. The normal transitional epithelium has practically disappeared and various gradations of metaplastic changes may be traced from the normal epithelium to solid glandular masses and extensive squamous-cell coverings. This process probably results from a combination of metaplasia with hyperplasia of the normal glands often seen in the mucosa of the bladder. Such glands, which generally consist of a few cells only, are well described by von Brunn and von Limbeck. Later Stoerck and Zuckerkandl described a glandular cystitis which developed into malignancy as a result of constant irritation. In exstrophy of the bladder the exposure to the air, the constant irritation of the clothing, the frequent trauma and persistent infection, with the possible need for a protective mucous covering or mucous secretion, furnish an excellent stimulation to cellular hyperplasia. The almost constant association of squamous-cell covering, a type of growth which is rarely formed unless a protective surface is necessary, gives evidence of the extent of the irritation and trauma.

Ewing states that the study of many adenocarcinomas indicates that the pure adenomatous structure may represent an intermediary or transitory stage in the evolution of the tumor, which is rapidly traversed and soon passes into a more typical carcinomatous phase. This progress is often seen in tumors of the breast; the dividing line between benign and malignant neoplasms is often questionable, and intermediate and border-line growths are often seen. In malignant prostates the various transitional stages from a benign glandular area may occasionally be traced to a definite area of malignancy.

Nine exstrophied bladders, removed from patients at the Mayo Clinic,

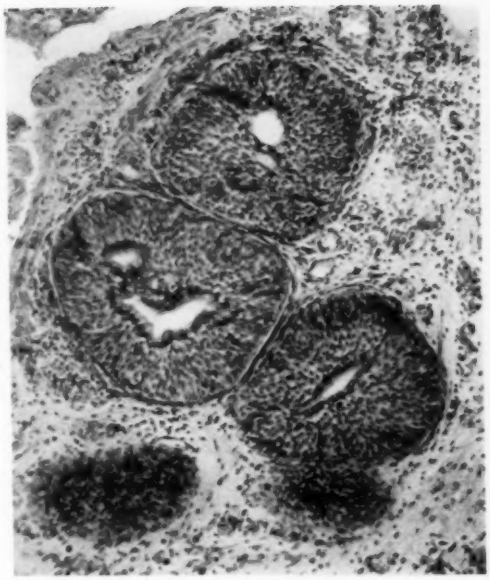

FIG. 1.—(Case 105862). High cylindrical cells lining the surface of inverted bladder mucosa (X 100).

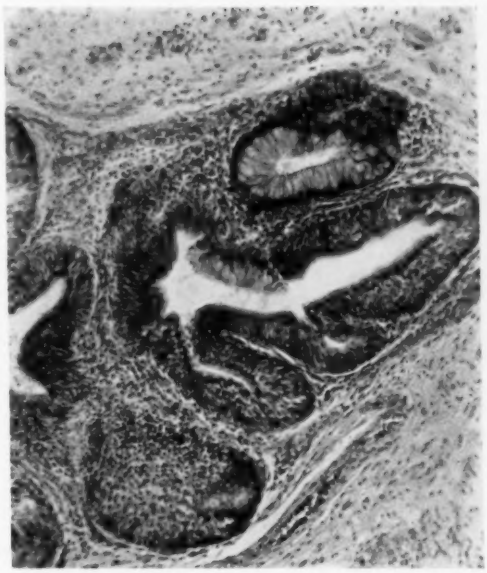

FIG. 2.—(Case 105862). Section of exstrophied bladder from an infant, showing early stage of transition from the normal mucosa to glandular type (X 100).

FIG. 3.—(Case 200894). Section from bladder showing large alveoli (X 50).

FIG. 4.—(Case 193182). Squamous cell surface from exstrophied bladder (X 50).

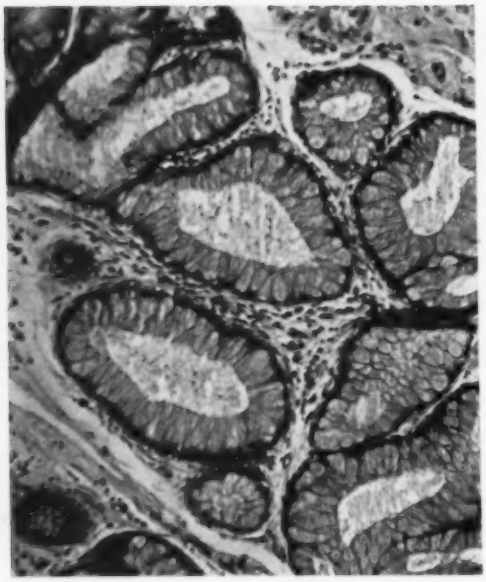

FIG. 5.—(Case 193182). Glandular area showing extensive mucoid degeneration of cells. Small dark nuclei located at base of cells (X 100).

FIG. 6. (Case 219383). Group of glands showing compact and irregular formation (X 50).

FIG. 7.—(Case 251343). Squamous covering of bladder overlying glandular area (X 50).

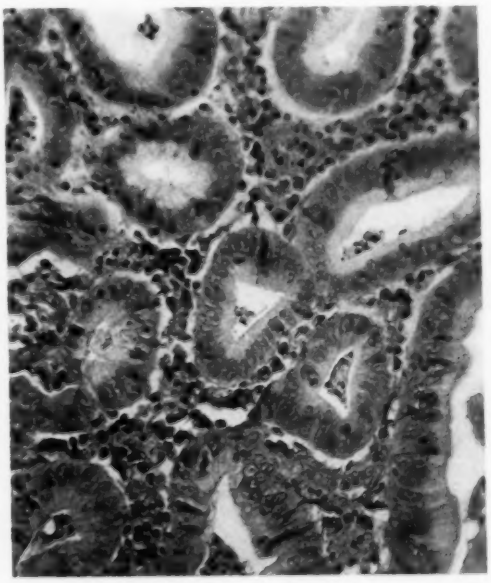

FIG. 8.—(Case 190148). Adenocarcinoma on exstrophied bladder (X 200).

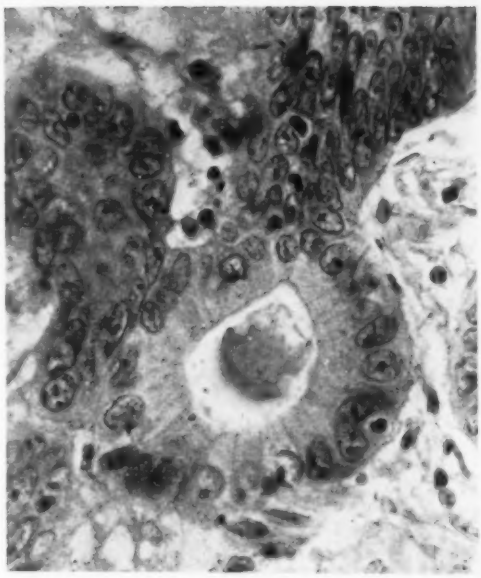

FIG. 9.—(Case 100148). Malignant cells with large irregular nuclei and prominent nucleoli (X 500).

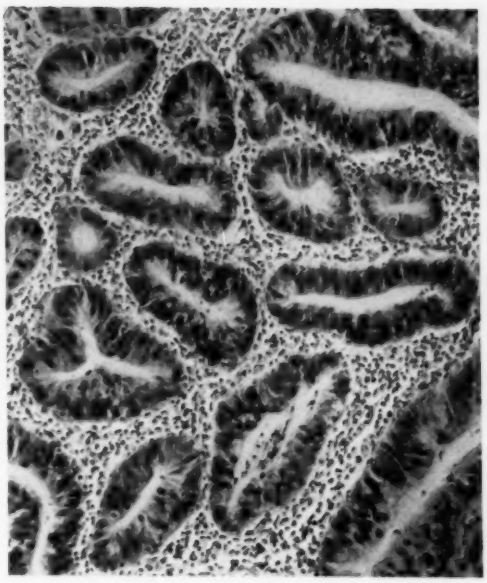

FIG. 10.—(Case 375285). Glandular malignancy from an exstrophied bladder in a man aged forty-four years (X 100).

FIG. 11.—(Case 375285). Papillary arrangement of glandular cells (X 500).

FIG. 12.—(Case 375285). Adenocarcinoma covering the left half of the exstrophied bladder. The ureteral orifices at the base of the bladder are not involved in the malignant area.

were examined grossly and histologically in an effort to establish the connection between the constantly present hyperplastic mucosa and the glandular malignancy which so often develops. Brief histories of these cases are given.

CASE I (105862).—H. L., a girl aged four years, was brought to the Clinic because of exstrophied bladder, May 12, 1914. The surface of the bladder was roughened and thickened; it contained many thin-walled cystic dilatations, a number of which were filled with a bluish colloid material. Microscopically a few small groups of glands with uniform and regular acini were seen. The cells composing these glands were of the high cylindric type; they were regularly disposed and were uniform in size and shape. In several areas the infolded surface layer of epithelium was seen to be undergoing glandular changes, such as large cylindric cells arising directly from the mucosa of the bladder (Figs. 1 and 2). In a few areas normal transitional epithelium was found, but in most instances the bladder and glandular areas were covered by thickened and hornified epithelium.

CASE II (200894).—H. McG., a boy aged six years, was brought to the Clinic July 12, 1919, on account of an exstrophied bladder. The surface of the bladder was roughened and contained many small dilated cysts. Clear urine was seen spurting from both exposed ureteral openings. At operation the bladder was removed completely and the ureters transplanted. Microscopic examination of the wall of the bladder revealed extensive areas of glands with irregular acini, some small and circular, others dilated and tortuous. Only a small amount of intervening stroma separated some of the glands. The cells lining a number of the alveoli were hypertrophic, irregular, and often contained very large deeply-staining nuclei. In a few areas the glands were lined by several layers of cells, and occasionally masses of cells were seen with glandular lumen practically obliterated (Fig. 3).

CASE III (226575).—T. B., a boy aged fifteen years, was examined in the Clinic March 28, 1918. He had a completely exstrophied bladder, the covering of which was red and inflamed from constant moisture. The bladder was removed and microscopic examination of the mucosa revealed many large unilocular cysts lined by two or three layers of flat epithelial cells. There were many long perfectly formed glands. The cells forming the alveoli were uniform in shape and arrangement; the nuclei were small, deeply stained, and situated at the bases of the cells.

CASE IV (193182).—Mr. A. Z., aged eighteen years, came to the Clinic May 14, 1917, because of an exstrophied bladder. The surface of the bladder was fairly smooth and regular. The openings of both ureters were visible, and spurting clear urine. Microscopic examination of the bladder after its surgical removal revealed a well-developed squamous-cell surface covering the entire bladder (Figs. 4 and 5). Below this many well-formed small glands were found. In a number of areas the glandular lumen opened directly on the surface of the bladder.

CASE V (219383).—Mr. J. M., aged twenty-one years, came to the Clinic January, 1918. He had an exstrophied bladder, the surface of

which was deeply furrowed and contained many cystic areas. The bladder was removed and microscopic examination revealed many regular and well-formed glands. In some areas many small alveoli were bunched together. There was moderate round-cell infiltration of the submucous tissues (Fig. 6).

Case VI (211574).—Miss P. C., a woman aged twenty-two years, came to the Clinic October 23, 1917, for treatment of complete exstrophy of the bladder. The surface of the bladder was fairly smooth and contained a number of small, projecting, glandular nodules. The ureters were transplanted to the rectum and the bladder removed. Microscopic examination revealed many large and small alveoli lined with high columnar epithelial cells and filled, often, with detritus. The individual cells were large and occasionally swollen and contained a faintly staining homogeneous material.

Case VII (251343).—Mr. C. S., aged twenty-five years, came to the Clinic for examination September 13, 1920. He had a small exstrophied bladder, which was removed. Microscopic examination of the mucosa revealed very extensive glandular formation; in some areas great masses of alveoli were matted together with practically no intervening stroma (Fig. 7). The individual cells showed hypertrophy and often contained large, deeply staining, centrally located nuclei. The glands were irregular and tortuous, and often large ducts opened on the surface of the bladder.

Case VIII (190148).—Miss L. W., aged twenty-three years, came to the Clinic April, 1917. She had a completely exstrophied bladder, which had recently increased in size. The upper half of the bladder was 3 cm. in diameter, firm, and irregular. The histologic examination after removal revealed well-marked adenocarcinoma. The growth contained many large and small alveoli, with great masses and strands of glands linked together. The cell layers were duplicated and in some areas the alveoli were represented only as a great mass of hypertrophied cells. The individual cells were irregular in size and shape and in general did not conform to the contour of the alveoli. The nuclei were extremely large, generally centrally situated and in most cases stained deeply (Figs. 8 and 9). In spite of the thorough removal of the growth, the patient died two years later from metastasis.

Case IX (375285).—Mr. L. M., aged forty-eight years, came to the Clinic October 20, 1921, for examination of a tumor on an exstrophied bladder. The growth had appeared on the left side of the exposed mucosa about one year before. During the last few months it had increased rapidly in size and had bled freely. On examination a large scar was found directly above the bladder, the result of an attempted repair of the exstrophy thirty years before. A rounded irregular tumor 4 cm. in diameter, which almost covered the bladder, projected above the mucosa about 2 cm. On raising the lower border of this growth both ureteral orifices were seen; clear urine spurted from each. Under local anæsthesia the mucosa of the bladder and the tumor were excised. Both ureters were found to be thickened and

dilated; they were not disturbed. The mass removed was moderately solid; it was covered with short stubby protrusions. Histologic examination revealed a typical adenocarcinoma which had spread into the surrounding mucous membrane (Figs. 10 and 11). In some areas the tumor was composed of heavy papillomatous projections resembling a papillary adenocarcinoma of the ovary or thyroid. There was marked round-cell infiltration consisting mainly of plasma cells. Sections taken through the prostate, closely associated with the misplaced bladder and removed with it, did not reveal malignancy (Fig. 12).

Discussion.—The mucosa of exstrophied bladders, particularly in adult patients, contains areas gradually approximating or shading off from fairly normal to definitely malignant tissue. In the youngest patient of the series (Case I) a moderate amount of normal epithelium was still present and the gland formation was only slightly advanced. In most instances the extent of such formation seems to vary with the age of the patient. The patient in Case II is an exception to this rule. In the specimen very extensive gland formation was seen. There was irregularity in size and shape, reduplication of the lining cells, large deeply staining nuclei, together with a disorderly rambling of the groups of glandular cells into the surrounding tissue. The histology in Cases VIII and IX, the two cases in which there was definite malignancy, was similar to that described by Ewing as adenoma destruens, a type of tumor which generally occurs in the large intestine, a portion of the bowel which embryologically is associated with the bladder. The glands were very extensive and were grouped together, forming large irregular masses. Stoerck and Zuckerkandl reported a similar case of adenocarcinoma on an exstrophied bladder occurring in a woman of fifty. They believed that the malignancy developed following hyperplasia of the mucous glands. Hager reported a case of adenocarcinoma developing on an exstrophied bladder in a man aged sixty-six years; the tumor covered the upper half of the bladder. Lower removed an adenocarcinoma from a man of fifty. The exstrophied bladder in this case was irritated by a metal appliance worn by the patient. Ehrich reported a case in a woman aged forty-four years, who died one month after the removal of the growth. In the region of the tumor, areas of thickened glandular tissue were found. Geraghty reported a case, seen at the Johns Hopkins Hospital, of an adenocarcinoma occurring in an exstrophied bladder. Similar cases are also noted by Enderlen and Bergenhem.

The striking feature about these tumors is that they are all adenocarcinomas, a type which would develop directly from hyperplastic adenomatous tissue. No other type of malignancy has been noted in exstrophy of the bladder. This is in marked contrast to the types of tumors occurring in normally situated bladders; adenocarcinoma makes up only about 2 per cent. of such growths. There were five adenocarcinomas in 333 tumors of the bladder treated at the Mayo Clinic.

It is difficult to estimate the relative frequency of malignancy in exstrophied bladders as compared with those normally situated. Marion states that the condition occurs about once in 50,000 births, and that nine-tenths of the patients die in infancy or a little later. In 367,000 patients at the Mayo Clinic there were sixty-nine with exstrophy of the bladder (one in 5318); in three of these the condition was malignant. The cases of two are described in this series; in the third the growth was inoperable.

The incidence of malignancy in exstrophy of the bladder is relatively high in reported cases as compared to the incidence of exstrophied bladders or to the incidence of malignancy in normal bladders. This relative frequency of malignancy, with the repeated occurrence of conditions approximating malignancy, suggests that exstrophied bladders should be removed as early as possible in all operable cases.

SUMMARY

Exstrophied bladders that are subject to constant irritation and trauma have an extensive glandular covering, the result either of metaplasia from the normal covering or of hyperplasia of glands in the mucosa. Such glandular structure often shows characteristics approximating malignancy. In nine cases of exstrophied bladder, in which material for histologic study was available, two were definitely malignant, and two showed atypical cellular formation varying markedly from the normal.

In the reported cases of malignancy of exstrophied bladders, which are relatively frequent, the growths were adenocarcinomas. This glandular malignancy is the type that would develop from irritation and hyperplasia of glandular structures.

BIBLIOGRAPHY

[1] Bergenheim, B.: Ectopia vesicæ; adenoma destruans vesicæ; exstirpation af blasan; implantation af uretererna i rectum. Eira, 1895, vol. xix, pp. 268–273.

[2] Bohm, H.: Plattenepithel und Plattenepithelkrebs in Mastdarm. Arch. f. path. Anat., 1895, vol. cxl, pp. 524–535.

[3] Broders, A. C.: Personal communication.

[4] von Brunn, A.: Ueber drüsenähnliche Bildungen in der Schleimhaut des Nierenbeckens, des Ureters und der Harnblase beim Menschen. Arch. f. mikr. Anat., 1893, vol. xli, pp. 294–302.

[5] Deetz, E.: Vier weitere Fälle von Plattenepithel-Krebs der Gallenblase, ein Beitrag zur Frage der Epithelmetaplasia. Arch. f. path. Anat., 1901, vol. clxiv, pp. 381–405.

[6] Ehrich, E.: Gallertkrebs der ekstrophierten Harnblase. Beitr. z. klin. Chir., 1901, vol. xxx, pp. 581–604.

[7] Eichholz, P.: Experimentelle Untersuchungen über Epithelmetaplasia. Arch. f. klin. Chir., 1902, vol. lxv, pp. 959–1013.

[8] Enderlen: Zur Ætiologie der Blasenectopie. Arch. f. klin. Chir., 1903, vol. lxxi, pp. 562–567.

[9] Enderlen: Zur Histologie der Schleimhaut der ektopierten Blase. Verhandl. d. deutsch. path. Gesellsch., 1904, vol. vii, pp. 167–170.

[10] Ewing, J.: Neoplastic Diseases. Philadelphia, Saunders, 1919, p. 648.

[11] Geraghty, J. T.: Tumors of the Bladder. In Cabot, H.: Modern Urology. Philadelphia, Lea and Febiger, 1918, vol. ii, p. 208.

[12] Haché, M.: Pathogénie et variétés de l'exstrophie de la vessie. Rev. de chir., 1888, vol. vii, pp. 218–227.

[13] Hager, A.: Ekstrophia vesicæ urinariæ mit Adenocarcinoma gelatiniforme. München. med. Wchnschr., 1910, vol. lvii, pp. 2300–2304.

[14] Lichtheim, L.: Ein Fall von Ektopie der ungespaltenen Blase. Arch. f. klin. Chir., 1873, vol. xv, pp. 471–475.

[15] Von Limbeck, R.: Zur Kenntnis der Epithelcysten der Harnblase und der Ureteren. Ztschr. f. Heilk., 1887, vol. viii, pp. 55–66.

[16] Lower, W. E.: Exstrophy of the Urinary Bladder with Carcinoma. Annals of Surgery, 1921, vol. lxxiii, pp. 354–356.

[17] Marion, G.: Histoire d'une exstrophie vésicale chez une femme. Presse méd., 1910, vol. xviii, pp. 145–148.

[18] Nicholson, G. W.: Three Cases of Squamous-celled Carcinoma of the Gall-bladder. Jour. Path. and Bacteriol., 1909, vol. xiii, pp. 41–48.

[19] Stoerk, O., and Zuckerkandl, O.: Über Cystitis glandularis und den Drüsenkrebs der Harnblase. Ztschr. f. Urol., 1907, vol. i, pp. 3–41; pp. 133–148.

[20] Vrolik: Quoted by Lichtheim.

[21] Zeller, A.: Plattenepithel im Uterus (Psoriasis uterina). Ztschr. f. Geburtsh. u. Gynäk., 1884, vol. xi, pp. 56–88.

INTERMITTENT HYDRONEPHROSIS WITH GASTROENTEROLOGIC SYMPTOMS*

By Alexius McGlannan, M.D.
of Baltimore, Md.

For a long time hydronephrosis has been known as the great mimic in abdominal pathology. The mass in an upper quadrant of the abdomen has been mistaken for a distended gall-bladder, a cyst of the pancreas and various other tumors.

The changes of urinary function in hydronephrosis are seldom great. Ordinarily the disease is unilateral and therefore systemic indications of urinary disturbance are rarely present. The tumor may never be large and during the periods of remission or intermission may become so small as to escape notice.

Disturbance of gastro-intestinal function may be the only constant feature of the condition. Dietl's crisis, characteristic of movable kidney and believed to have its origin in a vascular or ureteral obstruction, points out a reflex relationship between the urinary and alimentary organs.

Gastro-enterological symptoms therefore may become of the greatest importance in the course of an intermittent hydronephrosis. The possibility of the condition must be borne in mind whenever a confusing set of symptoms can not be explained by the presence of a clearly identified lesion of the alimentary tract or its associated organs. Under such circumstances a complete urological examination, including catheterization of the ureters, measurement of the capacity of the pelvis, determination of the function of both kidneys, and pyelograms will prove the presence or absence of a hydronephrosis.

Early in the course of the disease conservative operations, varying from dilatation of a strictured ureter to plastic anastomosis between this tube and the pelvis of the kidney, are to be performed. Late in the disease, when the accompanying progressive sclerosis of the pelvic walls and the kidney parenchyma has seriously impaired the function of the organ, nephrectomy is indicated. Before resorting to this radical operation, however, the possibility of improving the function of the kidney, after the pressure has been relieved, should be considered. This point may become of great importance when the condition of the other kidney is also below normal.

Hydronephrosis is not a rare lesion, and the two cases now reported are brought to your attention only because the gastro-enterological symptoms are so prominent in their clinical course.

Case I.—S., 1836. The patient, a white boy, age thirteen, was admitted to St. Agnes' Hospital, June 11, 1908, on account of recurring

* Read before the American Gastro-enterological Association, June, 1921.

pain in the abdomen, with nausea and vomiting and constipation. The symptoms had been present ten years. The boy had been studied by several eminent clinicians, but no diagnosis had been made.

The attacks came on without any relation to the taking of food, at intervals of about two weeks, and lasted from twenty-four to forty-eight hours. During the attack there was bulging of the left side of the abdomen, with a ball-shaped swelling at the outer border of the left rectus between the umbilicus and the anterior superior spine. The pain was colicky and referred to the region of the ball-shaped swelling just described, and to the costal margin in the left mammary line. The pain did not radiate in any direction. Recovery from the attack was prompt. Usually the next day the boy was able to go to school. During the interval he was entirely well.

Examination of the abdomen revealed a small bulging at the outer border of the left rectus muscle at the level of the umbilicus. Pressure at this point brought out gurgling and a sense of splashing. No other masses or areas of resistance could be felt. A peristaltic wave was seen passing downward with respiration from the tip of the xiphoid across the abdomen.

Dilatation of the bowel with air through a rectal tube showed even distention, except in the region of the cæcum. As the bowel became distended, the patient complained of pain in the left flank, similar to the pain during an attack. Bismuth X-ray showed a break in the shadow in the descending colon just above the sigmoid. This was attributed to air or fæces in the bowel. At the time of this examination (1908) our limited experience did not permit us to make any deductions from the X-ray plate. Sigmoid volvulus, and congenital dilatation of the colon were considered as possible causes for the symptoms. The blood count was normal and there were no pathological changes in the several specimens of urine examined.

While in the hospital the boy had an attack. Considerable bulging of the left flank was noted. The colicky pain was severe. The ball-like mass at the edge of the rectus was tender. There was frequent desire to urinate and a considerable quantity was passed with each voiding. As the attack subsided the bulging of the flank disappeared. After this attack the possibility of an intermittent hydronephrosis was considered as a cause of the boy's illness.

On July 3rd Doctor Bloodgood opened the left flank behind the peritoneum at the level of the umbilicus, by a muscle-splitting incision. The moderately distended sac of the hydronephrosis was identified and brought up to the surface. The wound was partially sutured and then iodoform gauze was packed around the sac to wall off the other tissues. The sac was opened by a minute incision. Urine began to flow at once.

The wound gradually healed, and closed down to a pinhead-sized urinary fistula situated in the flank. This fistula drained for nearly two years. At the end of that time, it was closed by separating the sac from the abdominal wall and plicating it until the several layers made a band of tissue about one-half inch wide firmly fixed against the side of

the kidney. This manœuvre was successful. The wound healed without complications and there was no more leaking of urine. The patient is now a vigorous and active young man, cured eleven years.

CASE II.—S., 20695. The patient, a white female, age seventeen, was admitted to the Mercy Hospital January 13, 1921, on account of constant pain in the abdomen, with nausea and vomiting. There were paroxysmal exacerbations of the pain. She had suffered from attacks of acute indigestion for some time, but a routine physical examination made in May, 1920, did not reveal any masses or tender areas in the abdomen.

The present attack had begun about two weeks before admission with acute indigestion followed by diarrhœa and pain in the upper left quadrant. At the time of admission there was a disk-like mass about the size of a silver dollar, just under the outer edge of the left rectus muscle, about two inches above the umbilicus. This area was tender and was flat on light percussion. This disk-like mass was considered part of a larger smooth, firm, swelling which extended upward to the costal margin and outward to the anterior axillary line.

The large swelling was regular in outline and moved with respiration and from side to side. The tender area was taken to be a mass of omentum, plastered over a slowly leaking gastric ulcer, and binding it to the abdominal wall. The stomach contents were free from blood and contained less than the normal quantity of acid. X-ray study showed a dilated stomach with a remarkable zone into which the bismuth did not penetrate (Fig. 1). The colon picture was negative. The gastric shadow was interpreted as one due to extra-gastric tumor behind the stomach, or a polypoid growth within the organ. A few days later the pain became much less severe and we noted that the mass in the flank had become smaller. Later the mass recurred and with it the pain. We then felt reasonably certain that we were dealing with a hydronephrosis.

The urological study made by Dr. A. J. Gillis showed a phthalein output of less than five on the left and of forty-five on the right side. There was some difficulty in passing the catheter through the left ureter. The sodium iodide pyelogram showed clearly the dilated ureter and the swollen pelvis of the kidney (Fig. 2). Because of the low phthalein output of the left kidney and the good output of the right one, we decided to remove the functionless kidney rather than risk a urinary fistula in the attempt to do a plastic operation.

Operation, January 24, 1921. McGlannan. Anæsthetic, nitrous oxide. The mass was exposed by a lumbar incision. The sac was aspirated and 550 c.c. of fluid recovered. The kidney and the sac and about two inches of dilated ureter were removed. The wound was closed with drainage and healed without any complications. The patient is now well.

Analysis of the fluid from the sac showed it to contain a small quantity of urea. It was free from albumin or sugar. Examination of the sediment after centrifugation revealed a number of poorly stain-

FIG. 1.—Case II. Röntgenogram of stomach showing the area which was not reached by the barium-meal.

FIG. 2.—Case II. Pyelogram showing the dilated ureter, swollen kidney pelvis and cystic cavities.

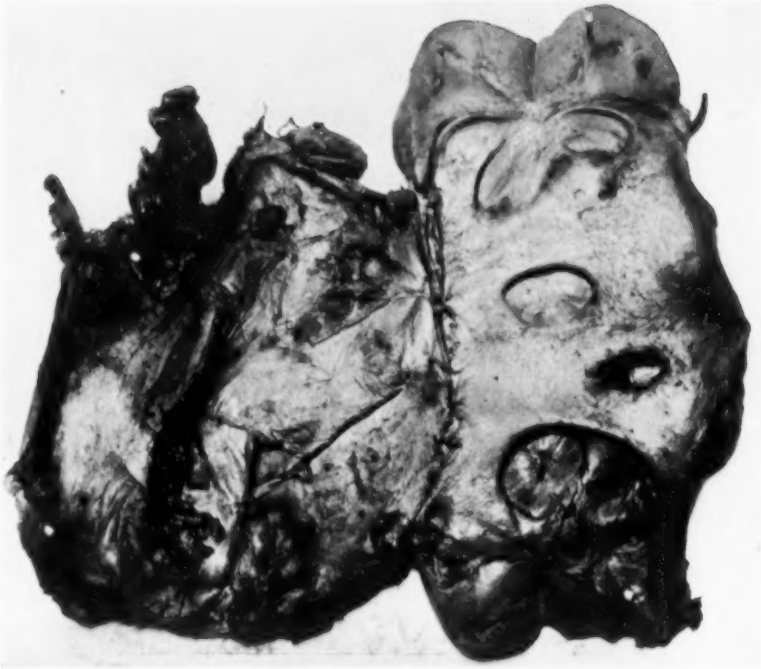

FIG. 3.—Case II. The excised kidney and hydronephrotic sac.

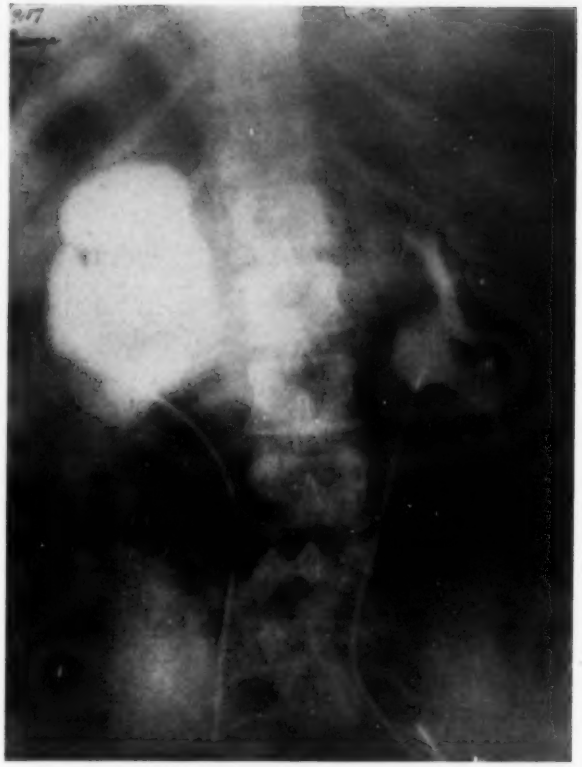

FIG. 4.—Pyelogram from Doctor Samuels' case.

ing cells with single nuclei, some bacilli which resembled the colon bacillus. There were no white blood-corpuscles present.

Gross pathology: The specimen consists of the kidney, the hydronephrotic sac and about one inch of ureter. The ureter is dilated, its walls are thin and the lumen is about 1 cm. in diameter. The sac is thin walled and has a capacity of about 500 c.c. The cut surface of the kidney shows a small area of parenchyma at either pole and around the convex border. The greater portion of the kidney is made up of cystic areas which are the dilated calyces. Between these cystic dilatations the tissue is gray and fibrous. The photograph (Fig. 3) shows the kidney cut open with the hydronephrotic sac attached at the hilum. A thin layer of kidney tissue is shown at the outer edge of the sac.

Through the courtesy of Dr. A. Samuels, I am able to add the report of another case of gastro-intestinal disturbance due to hydronephrosis.

The patient was a white woman, thirty-five years of age, who had suffered for three years from attacks of abdominal pain with vomiting. The symptoms were not associated with the intake of food. An operation, whose nature could not be learned, had been performed through an epigastric incision soon after the onset of her symptoms, but it had not given her relief. The attacks varied in their frequency and in severity. She had passed through two pregnancies since the onset of her symptoms and thought the recent exacerbations might be due to another pregnancy. The physical examination proved that the patient was not pregnant and discovered a tender, smooth mass in the region of the left kidney.

Urological examination showed that the left kidney held 1500 c.c. of fluid, while the right one had a 20 c.c. capacity. The phenolsulphonphthalin test proved the left kidney functionless. The pyelogram showed the hydronephrotic sac (Fig. 4).

The patient was cured by nephrectomy.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

Stated Meeting Held December 14, 1921

The President, Dr. John A. Hartwell, in the Chair

BRAIN TUMOR WITH FEW LOCALIZING SYMPTOMS

Dr. Charles A. Elsberg presented a woman, twenty-four years of age, from whom he had removed a large tumor from the right parieto-frontal region about one year ago. She complained of continuous severe headache and interference with vision. Physical examination showed nothing with the exception of a high grade of papillœdema with hemorrhages in both eyes. Neurological examination was entirely negative. Vision finally began to deteriorate rapidly and it was determined to do a decompression. A few days before the operation the patient complained of a peculiar sensation in the right cheek, and upon examination there was found a slight diminution in sensation of the right cornea. Based upon this, Doctor Elsberg determined to expose the right frontal and parietal lobe and to investigate whether there was a neoplasm which caused pressure upon the first and second branches of the right trigeminus. At the operation a large endothelioma, measuring 5x7x4 centimetres was removed from the right fronto-parietal region. The patient's headaches disappeared at once and she has been entirely well since that time, excepting that she presents some signs of frontal lobe disturbance.

CYST OF THE CEREBELLUM

Doctor Elsberg made some remarks upon the sensitiveness of the medulla if the least pressure is made upon it acutely, and then presented the following case to show what the medulla will withstand if the pressure is a very gradually increasing one. The patient was a boy, twelve years of age, who presented symptoms of a left cerebellar lesion of six months' duration. He was markedly ataxic in all extremities. In November, 1918, Doctor Elsberg did a suboccipital craniotomy and emptied a cyst in the left cerebellar lobe, cauterizing the inner surface of the cyst with pure carbolic acid. The patient remained perfectly well for two years and then all of the symptoms recurred with again a marked papillœdema and marked ataxia. A second operation was done in June, 1921. At this operation a large cyst was again found, but this time the cyst involved not only the left cerebellar lobe, but extended across the median line into the right cerebellar lobe. The cyst contained a large amount of yellow fluid. The fluid was evacuated, one or two small gliomatous knobs excised and the whole cavity swabbed out with Zenker's solution. The patient recovered from the operation very satis-

factorily, the papilloedema subsiding very rapidly and all of his symptoms disappeared. He is now free from symptoms, except for a slight dysmetria in the left upper extremity.

RECURRENT SPINAL CORD TUMOR

DOCTOR ELSBERG presented a young man, twenty-eight years of age, who, in 1919, had been admitted to Mount Sinai Hospital with the signs of an extramedullary compression of the spinal cord at the sixth cervical level on the left side. At the operation on May 14, 1919, a spinal cord tumor lying on the left side and in front of the cord was removed. The pathological report was fibroma. The patient recovered very satisfactorily from the operation and remained perfectly well for two years. He then returned to the hospital with the story that for six weeks his symptoms had begun to return, and they were at the time of his admission as severe as they had been before the previous operation. The signs and symptoms again pointed to the sixth cervical segment of the cord. A second laminectomy was done by Doctor Elsberg on June 7, 1921, and another tumor of about the same size as the previous tumor was removed from the same location of the cord. The tumor was well encapsulated and easily removed, as had been the first tumor. The pathological report on the second tumor was spindle-cell sarcoma, and when the pathologist reëxamined the first tumor which had been removed, he found a small area undoubtedly sarcomatous, and therefore changed the diagnosis on the first tumor to that of spindle-cell sarcoma. The patient recovered very satisfactorily from the second operation and was presented practically well.

Doctor Elsberg remarked that this was the first case of true recurrent intradural tumor that he had ever encountered.

SPINAL SYMPTOMS COMPLETELY RELIEVED BY LAMINECTOMY

DOCTOR ELSBERG presented a girl, twenty-five years of age, upon whom he had operated in February, 1921. The patient had a thirteen months' history of pain in the lower right chest, coming in attacks, and diagnosticated as "dry pleurisy." She had had some trouble in the lower extremities when she was admitted to the Neurological Institute. Upon examination she presented signs of compression of the cord at the seventh thoracic segment. A laminectomy was performed on February 21, 1921. Excepting for a slight thickening of the arachnoid and an apparent localized collection of fluid under the arachnoid, nothing pathological was found. The wound was closed and the patient made an uncomplicated convalescence. All her motor and sensory signs disappeared and she has been free from pain and feeling perfectly well since that time.

Doctor Elsberg remarked that this was one of the effects that one sometimes sees from an exploratory laminectomy. While the thickening of the arachnoid may have had something to do with her symptoms, there was not sufficient pathologically found to explain her symptoms or to explain the complete relief after the laminectomy.

SPINAL CORD TUMOR; LAMINECTOMY; COMPLETE RECOVERY

DOCTOR ELSBERG presented a woman, forty-eight years of age, who had had a complete spastic paraplegia with paralysis of the bladder and rectum when he operated upon her in June, 1921. At the operation a tumor, 3 x 2 centimetres in size, adherent to the dura, was removed from the level of the sixth and seventh thoracic segments. The patient rapidly regained what she had lost. She had complete control over her bladder one week after the operation, and within six weeks of the operation had regained entire control over the extremities. She was presented without an evidence of either motor or sensory disturbances, and feels perfectly well.

RECONSTRUCTION OF COMMON BILE DUCT

DR. FRANK S. MATHEWS showed a patient first seen at the age of twenty-two. Eight months previously her gall-bladder, which contained no stones, had been removed for unknown reasons. Following the operation, all bile drained externally. As the sinus narrowed, chills and fever developed and she was reoperated upon, nothing being done but an opening of the wound to promote drainage.

When seen by Doctor Mathews all the bile was draining externally. Sinus would close for a few hours, followed by a chill and fever. At his first operation a sinus was found leading to the transverse fissure and directly into the liver. No stump of duct remained connected with the liver. The hepatic duct lay an inch and a quarter from the fissure. The end was opened and efforts made to suture it in contact with the under surface of the liver. The operation had been very long, blood loss considerable and patient was much shocked and required transfusion. The wound was infected and a total failure as far as restoration of the duct was concerned. However, the condition to be dealt with had been learned, the chills terminated and patient's general health restored.

Six months later, in August, 1920, with patient in good condition, an operation for reconstruction was undertaken which has proven a complete success. At the time of operation patient was three months pregnant. The duodenum was separated from the hepatic and common ducts, exposing them for a considerable distance. The closed end of the duct was opened and a rubber tube inserted in the open end of the duct. Some distance below and just where crossed by the duodenum, a small incision was made in the side of the duct just large enough to admit the tube. The other end of the tube was inserted three inches into the liver and the end of the duct held in contact with the liver by means of two or three chromic sutures. It seemed simpler and easier to bring the tube out of the small lateral opening in the duct than to attempt to pass it down through the common duct into the duodenum. All the bile drained through the tube and none around it. The tube was removed on the seventeenth day. There was no drainage of bile from the sinus and the color returned to the stools at once. No apparent impairment of health could be traced to the total absence of bile in the intestine

for a period of two years. The pregnancy was not interrupted by the operation.

DR. JOHN DOUGLAS presented a woman fifty-six years of age, who was operated on at St. Luke's Hospital in October, 1919, for acute cholecystitis. The gall-bladder was acutely inflamed and contained a number of stones. The wall was necrotic and there was considerable bile-stained fluid in the portion of the peritoneal cavity surrounding the gall-bladder. The common duct contained sand-like material and detritus but no stones. The gall-bladder was removed, and in its removal the cystic duct pulled off from the common duct, injuring the wall of the common duct but not dividing it. The débris from the common duct was removed through this opening after enlarging it. The opening of the common duct was partly closed by suture and a rubber tube inserted upward for drainage. There was a high temperature and infection of the wound following the operation, and a biliary drainage existed for from six to seven weeks. The patient then left the hospital with a sinus still present with no bile drainage. She returned to the hospital in January, 1920, with an area of cellulitis about and above the operative incision. At this time it was found that there was a necrosis of several of the costal cartilages above the operative incision. She remained in the hospital until April, 1920, and went home healed. In August, 1920, she became jaundiced. This jaundice never entirely disappeared, but she had attacks of pain in the right hypochondrium, accompanied by chills and fever, at which time the jaundice would become more severe and then later become less. She is sure that since this time her fæces were always clay colored.

In October, 1921, two years after her first operation, she again entered the hospital, with marked jaundice; the skin and conjunctiva were of a dark greenish-yellow color, the stools were clay colored, the urine contained a large quantity of bile and no bile could be obtained by the duodenal tube. She had no temperature elevation. Coagulation time was three minutes. At the second operation the common duct was found without great difficulty as there were a surprisingly small number of adhesions. It was identified at the distal end by aspiration of mucus by hypodermic needle. Above this closed end was a strand of connective tissue which led up to a point just below the junction of the two hepatic ducts which was closed off tight and distended with bile. This was also identified by aspiration with a hypodermic needle. The two ends were opened, mobilized and sutured together with chromic gut about a T tube. This tube was sutured into the wound to prevent pulling out. After the operation part of the bile drained through the tube, and a considerable quantity immediately entered the intestines as the movements were bile stained. On the twelfth day she accidentally pulled out the tube. There was some discharge of bile from the wound for twenty-four hours, none thereafter. The wound healed rapidly and since the time of operation the patient has had no return of her pain or temperature. Her jaundice has disappeared and her movements are normal in color.

The particularly interesting facts about this case are: First, that

the stricture of the duct must have been due principally to pressure of the drainage tube, plus infection, as the duct certainly was not divided at the time of operation. Second, the fact that the external sinus closed, although the common duct was completely obstructed, as a rule these cases having a permanent or intermittent fistula. Third, the long period during which a complete or almost complete closure of the common duct must have been present. Fourth, the short coagulation time of the blood and the presence of a marked jaundice.

Doctor Douglas asked the members of the society how long they thought the arms of the T tube should be, as, of course, the longer the arms the easier the tube would stay in place, and also the more difficult it would be to remove the tube, and the more chance of injury to the anterior wall of the duct in removing the tube. He also inquired how long the members of the society, who had any experience with the use of the T tube in such cases, believed that the tube should be left in place before removal. It had been his intention to leave the tube in from three to four weeks, but the patient accidentally pulled it out at the end of twelve days.

Dr. John F. Erdmann said that he had had six of these patients, four of whom recovered while the other two cases resulted fatally. In each instance he used a small-sized catheter, introducing it high into the hepatic duct or the remains of the common duct, the terminating end of the catheter with its extra length being introduced into the duodenum either through the common duct, if it could be found, or a new opening being made in the duodenum, the catheters being fixed in the ducts with one or two stitches of chromicized catgut. In the first patient upon whom he used this method the catheter was passed in about the eleventh week. When she came to him there had been continuous loss of bile and her weight had gone down from 125 to 87 pounds. At the time of operation there was great difficulty in finding the proximal orifice and the distal orifice could not be found. At the end of about eighteen months this patient had to be reoperated upon for stenosis. At the time of the second operation the duodenum was attached to the opening of the hepatic duct. This patient is now living and is in excellent health.

The second patient had been operated upon at another hospital in the city. When Doctor Erdmann saw her she was suffering from jaundice and spasms and there was a slight amount of leakage from the abdominal wall. At operation an obstruction to the common duct was found. The same type of procedure was followed as in the first patient. The catheter was found in the cæcum at the end of the seventh or eighth week. At the end of the seventh month it was still visible in the large intestine. Since that time X-rays have not shown any retained tube.

The fourth patient died of pneumonia; the fifth, his own, died of shock. In this patient he cut off a portion of the hepatic duct as a result of the spinal attachment of the cysticus to the common duct.

The sixth patient was a man upon whom he operated two years ago. He found the proximal end very easily as a bulbous mass on the

under surface of the liver—in other words, the opening of the hepatic duct. The man got along exceptionally well, but has since been operated upon twice, and is now ready to undergo a third operation at still another man's hands.

He never had used the T tube, feeling that the extraction of this tube would tend to traumatize the newly repaired tissues. In four of these patients he operated through the old perpendicular incision; in the other two he made a T incision by splitting the right side down to the mid-axillary line.

Dr. Allen O. Whipple said that the point brought up regarding the pressure of the drainage tube as a factor in stenosis he thought to be extremely important. In certain cases this factor would seem to be the only explanation for subsequent stricture. In two cases of stricture that he knew of, where the operators in their account of the operation made very clear the fact that the common duct was in no way injured, subsequent stenosis was explained only by pressure of the drainage tube. It is worth remembering that the drain should be kept well to the right and away from the gastro-hepatic omentum. This is very true in cases associated with infection.

Dr. Seward Erdman related an experience with one case in which the common duct had been completely divided. On the tenth day he did a reconstruction operation and found it possible to approximate the cut ends of the duct over a T tube which he left in for twenty-eight days. The cut ends were found separated by a distance of 2 cm. It seemed advisable to leave the tube in for a long time, so he did not remove it for twenty-eight days, after which time there was a little discharge from the sinus for about a week. The woman remained well for six months, but she is now (ten months after operation) suffering from symptoms of stricture, has occasional attacks of jaundice, colic, etc., and will have to be reoperated upon. Where there has been a large amount of scar tissue formation he did not see how stricture can be avoided, and unfortunately little has been written concerning the late results in reconstruction cases.

Dr. Alexis V. Moschcowitz said that a few years ago he was interested in the subject of necrosis of the costal cartilages, and in looking up the literature he found a considerable number of cases had followed operation upon the gall-bladder and ducts.

Doctor Mathews said that he had had three cases in which the common bile duct had been damaged at operation. In the first case the patient had drained bile for eight months after operation. The sinus had finally closed and was followed by jaundice and occasional chills. She was in this state when first seen. Operation consisted only in reëstablishing external drainage. Some days later hemorrhages began which were controlled for several days by transfusion. She died following the fourth transfusion. The second patient has been operated on three times by me and is now reasonably well. She had had three previous operations on the gall-ducts. He had never been able to quite demonstrate the pathological condition. The longest operation he had ever done—namely three hours and twenty minutes—was one of the three on this patient. The third case is the one shown this

evening. The method of reconstruction of the duct around a tube passed into the duodenum, as mentioned by Doctor Erdmann, has been frequently employed. In the case shown it seemed simpler and easier to bring the tube onto the abdominal wall through a small incision in the side of the common duct.

Doctor Douglas, in closing the discussion, said that while in his case the result up to the present time had been excellent, it would appear that in a large number of these cases, as illustrated by one of those reported by Doctor Erdmann, the scar tissue which formed in repair again closed down, and it necessitated another operation or reconstruction of the duct; and that it would be interesting to follow a number of these cases which have been repaired by different methods to determine if one method had any advantage over another, and was less apt to result in cicatricial contraction. As, for example, the method reported by Mayo in which the duodenum is mobilized and brought up, and an opening therein sutured directly over the stump of the common or hepatic duct.

PULMONARY LOBECTOMY

Dr. Howard Lilienthal read a paper with the above title, for which see p. 257. He also presented five patients whose cases are reported in the paper.

Dr. Paul W. Aschner (by invitation) read a paper entitled Pathology of Lung Suppuration, illustrated by lantern slides, for which see p. 321.

Dr. James Morley Hitzrot said that his experience covered five cases of the type under discussion, one an abscess due to a bullet wound, one followed tonsillectomy, two followed some type of pleural infection, and one was a tumor of the lung—small round-cell sarcoma. There is one point in Doctor Lilienthal's paper to which he would particularly refer, namely, too early attempt at lobectomy in the cases which follow tonsillectomy. In one of his cases the operation was done twelve weeks after the onset of the symptoms. The left lobe was removed and the lung showed the miliary abscesses described by Doctor Lilienthal. The patient survived the operation, but the wound in the chest wall became infected and a rapidly sloughing gangrenous process caused her death from infection. He believed with Doctor Lilienthal that this may be avoided by delaying the operation.

In the case with the bullet wound he tried to take the lung out and was successful, but the man died of massive thrombosis, probably of the heart. The tumor case died five months after operation from metastasis. The others are well.

Dr. Willy Meyer said that after experimental work in lobectomy, resection of the lung in dogs at the Rockefeller Institute in 1908 and 1909 with seventeen recoveries in twenty-one operations, when they saw the dogs jumping around and loudly barking after three to four days with the empty pleural cavity filled with air in every instance, not with serous fluid as found by other investigators before, they naturally approached the subject of lung resection in man with great enthusiasm. He operated in the spring of 1910 at the Lenox Hill Hospital on a boy with advanced bronchiectasis of the left lower lobe. He proceeded as

he had done in the dogs: intercostal incision, rib spreader in place, separate ligation of the blood-vessels accompanying the bronchus. When he was ready to tie the crushed bronchus the anæsthetist reported the boy had died suddenly. He never found a satisfactory explanation of this death except by vagus reflex. Naturally, this experience was a damper on his enthusiasm. A few weeks later Professor Friedrich, of Marburg, came to America as the guest of the American Medical and the American Surgical Association. When told of this recent experience, he said: "Doctor Meyer, do not be too aggressive; do not extirpate suppurating lungs right away. Rather go slow. Thoracic surgery is just taking a hold on the medical profession, and if many patients die from lobectomy the whole new chapter might get a black eye. Try conservative operative measures first." Doctor Meyer had faithfully followed this advice—on looking back, partially to his satisfaction and partially to his regret—and carried out every conservative operation known in the surgical treatment of bronchiectetic lung abscess. He tried artificial collapse of the lung (artificial pneumothorax), ligation of the branch of the pulmonary artery, thoracoplasty, peroral endoscopic treatment (bronchoscopy) with aspiration, also irrigation of the bronchial tree by a specialist, and incision of the lung abscess. He also tried resection of the lung in five cases, but cannot show the results that Doctor Lilienthal has shown to-night. The last case referred to, a young boy with lung suppuration, required excision of the entire right lung. Pharyngeal anæsthetization was carried out. At one time during the operation the boy was very cyanotic. Pathological examination proved the cause of the suppuration to be lymphosarcoma. The patient stood the operation well but developed a high temperature in the night following and died. Autopsy was not permitted.

Some of these cases can be greatly improved, if not cured also, by other methods than resection of the lung. He saw satisfactory results in a case of ligation of the respective portion of the pulmonary artery, also after repeated endoscopic treatment, and after incision of the lung abscess. For instance, a young man with ligation of the branch of the pulmonary artery of the lower lobe, done eight years ago, is now comparatively well, expectorating not more, if any, than 15 to 30 c.c. of mucopurulent pus in twenty-four hours. He is married, lives in the South and attends to his business. A young girl with bronchiectasis subsequent to tonsillectomy came for treatment from California several years ago; she almost died during the journey across the continent. Doctor Yankauer bronchoscoped her and found all three lobes of the right lung were involved. Radical operation was neither advised nor considered by her relatives. Doctor Yankauer used endoscopic irrigation at regular intervals. That girl has almost completely recovered and is now on the stage. In an early case of this type a young married lady, also subsequent to tonsillectomy, endoscopic treatment with aspiration, done at the Lenox Hill Hospital by Doctor Lynah, brought the high fever down to normal; there was such pronounced general improvement after one treatment that the patient left the hospital, though against advice.

A patient with bronchiectatic lung abscess in the right upper lobe, after aspiration during operation, was cured by pneumotomy. In a young man, who came under his care in a deplorable condition due to bronchiectasis of the left upper lobe with incised local empyema, conservative treatment, carried out with the intention of establishing a fistula, brought great improvement. The fetid expectoration stopped completely. Today he is able to ride a bicycle, has even dared to play tennis, is in business and happily married. He has a typical lung fistula and was emphatically advised against going on the water; nevertheless he has become an enthusiastic fisherman.

But it must be said and emphasized that in advanced cases of bronchiectasis, if one wants to have these patients completely recover, only resection of the lung can be considered.

Dr. Nathan W. Green said that it is a good thing to know that these distressing cases can be cured; 58 per cent. of cures is a very satisfactory showing considering the severity and the newness of this class of operations. In thoracic conditions the surgical question is flanked by physical and physiological problems that do not occur in abdominal surgery. These two classes of problems act as a right and left guard to keep us from attacking successfully the pathological centre. However, as we overcome them we are getting more toward the direct meeting with the problems of surgery in the chest. He understood that Doctor Lilienthal waits for about one year to be sure there is no tendency toward spontaneous recovery. Such delay is very desirable. Doctor Meyer mentioned the fact that he has tried different means before resorting to resection of the lung and he has had palliative results which are good. Thorough preparation both remote and immediate is essential. Doctor Lilienthal's efforts are reënforced by his organization of operating and nursing staff and he can do this special operation quickly which in many general hospitals cannot so readily be done because of the rotating staffs. That is a great help in this class of work. He speaks of thoracotomy as not being a severe operation. He could corroborate that; with a dose of morphine beforehand it can be done under local anæsthesia. But local anæsthesia is not advisable when manipulation of the thoracic viscera is contemplated. These operations should not be over an hour in length. Differential pressure should be always at hand and closed potential drainage of the Kenyon type should be employed. When the late Dr. H. H. Janeway and he were working on dogs they found that opening the pleural cavity for over an hour resulted in septic pleuritis.

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